The Long Range Hunting Series

The Practical Guide To

Bolt Action Rifle Accurizing & Maintenance

Nathan Foster

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(2nd Edition)

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Other books by this author

The Practical Guide To Long Range Hunting Rifles

The Practical Guide To Long Range Hunting Cartridges.

The Practical Guide To Reloading.

The Practical Guide To Long Range Shooting.

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Introduction

In book one of our series we explored the fundamental principles of the accurate rifle. Now it is time to get our hands dirty. In this third book I have tried to avoid going back into theory, instead focusing on each manual task of the rifle accurizing process. There are some instances where the reiteration of theory and accuracy fundamentals cannot be avoided; however, this will simply ensure that all information is driven home. This book is primarily intended for end users, you do not have to be a gunsmith to read this book and follow each task. However, gunsmiths can use this book as a method manual which not only covers setup and testing procedures but also covers rifle bedding to a high level of detail.

I have not gone into such processes as rifle blue printing, as this is beyond the abilities of most end users and would make for a daunting task list. In this sense, all we are wanting to achieve is to take a rifle, new or second hand, and do our very best to exploit its full accuracy potential within our means. Flaws which require machining are relegated to the gunsmith with specialized tools and machinery.

Before we begin we must develop the right mindset, this is extremely important.

Your rifle, no matter how fancy it may look during inspection, should be treated in your mind as a raw, unfinished item. A knife that has yet to have a honed edge. It is the same, whether you buy new, custom or second hand; treat each rifle as an unfinished tool. It is your responsibility to complete the process.

Within the pages of this book I will take you through my own methods of developing and maintaining an accurate rifle. This book will not deal

with handload development as this is a separate subject which needs to be addressed in detail within another book.

I think one of the worst things a shooter can go through after discovering poor accuracy is the “is it my loads or the rifle” type of thinking which leads to an incredibly wide range of variables. This can be frustrating to the point of mental exhaustion. Many of you have been through this, so you will understand me when I say that we must first try our best to set up our rifles properly to remove the rifle as a variable - as best we can.

This book is therefore divided into two main parts. The first is the rifle set up, which is subdivided into mock set up for testing versus the final set up. Part two of the book deals with ongoing maintenance.

Please note that any solvent products mentioned within this book must be considered as examples only. There is no point in me saying that X product is *the only* product to use because in a decade from now, that product may no longer be in existence. So it is up to you to use your own common sense and good judgment as to how to utilize this book in conjunction with solvents and general maintenance products.

As you read along it may occur to you that the set up process is somewhat complex. With practice you will soon have each of the steps down pat as a simple series of procedures. One thing that may stand out is that my procedures are quite different to those you may be given at the gun store or in a rifle owner manual or in a chat forum. But within these pages I hope that you will see why I am able to take a stock rifle and tune it to shoot with extreme accuracy where others might fail. There is no magic to this, just a series of procedures which I have learned by trial and error over many years.

I also want you to adopt or maintain safe practices. I know that you all find safety warnings tedious; we all know rifles are dangerous - apart

perhaps from those who use firearms as wedding trumpets. It is just so obvious: a killing tool is, well, potentially lethal. It doesn't get any simpler than that. Just promise me that you will keep an eye on your rifle chamber, make sure it is kept clear when you are not firing your rifle or stalking at the ready. Keep the magazine of your rifle empty when you leave the field. Take extreme care when handling, adjusting and testing your trigger and safety mechanism. Always point the muzzle of your rifle in a safe direction - always. Try to avoid working on your rifle when you are too tired. Keep your rifle workspace tidy, well organized and free from distractions. The more experienced you are, the more cautious you need to be. New players are often quite paranoid about rifle work, more experienced operators can easily make mistakes as a result of complacency and overconfidence. So, the more experience you gain the more careful you need to be.

Record keeping is a very good way to help keep us on track and working in a safe manner. I tag and bag all rifle parts during dis-assembly, I keep notes of where I am at with a job, the same as I take down reloading notes. This allows me to walk away from the job for a break without having to be reliant on my memory. A camera is also very handy for keeping track of your jobs and parts assembly.

If you have a parts breakage or, for example, a trigger that you are unsure of regarding its safe operation - replace it or take the part to a gunsmith. If you make a mistake and damage a part, don't hide it. You are not the first person in history to have made a mistake. We all make mistakes. If you need help with a broken or unsafe part - get help.

Part 1 - Preliminary inspection, rifle setup and testing

Before we commence, there is one very important consideration: Warranty. If you have a new rifle, it may come with a warranty. You will need to ask your gun store what kind of support is offered in this regard. Much will depend on your location, because in some remote areas support can be very limited. In other instances the support system is little more than lip service, the importer doing his very best to discredit the customer - a dirty but very common game.

If you have access to a warranty service, it is important to understand that any alterations made to the rifle will void the warranty. To this end, perform thorough inspections prior to any alterations.

My kit list

The following is a list of my kit for both testing and maintenance. Some items such as the torque wrench are critical, especially for those with less mechanical experience, some are simply useful.

- **Safety glasses (use especially when handling springs).**
- Torque driver set (multiple heads including hex, torx, phillips, flat). Wheeler FAT wrench or Borka torque driver recommended.
- Loctite 248 stick. Note, liquid Loctite can migrate under pressure into barrel threads when fitting scope bases, making future barrel removal a chore for smiths.
- Cotton buds - lots of cotton buds.
- Fast cure or super strength 2 pot syringe type epoxy.
- Axle grease (I currently use Lanolin based).
- CRC Soft Seal (CRC SP-400). Corrosion protection.
- Small stiff artist brushes for applying grease.
- Synthetic motor oil.
- CRC Long Life (CRC SP-350)

- Fluna Tec dry film lube/barrier.
- Hoppe's No.9 as general solvent (Collings and Brady solution in NZ).
- KG 1 Carbon remover.
- Brake cleaner (spray degreaser for cleaning)
- 3M Scotchbrite pads, maroon, grey and white grades. (Norton Bear Tex pads equally effective).
- Autosol paste or JB paste.
- Copper fouling remover. I am currently using Bore Tech Eliminator or KG 12.
- Rubber coated or graphite cleaning rod.
- 4x2 cleaning flannelette cleaning cloth.
- Bronze brushes and nylon brushes.
- Auto body filler for mock bedding.
- Lens cleaning brush and microfiber cloth.
- Lens cleaning solution.
- Wife.

Other items may include:

- Borescope.
- Valve grinding paste.
- Aluminum oxide buff grit (or firelapping grit).
- Armor All (cleaning synthetic stocks).
- Teak oil for wood stocks.
- Wood stain.
- Touch up blue.
- Your choice of barrier coating in lieu of CRC Soft Seal-Lanacote spray, fisholene etc.
- Touch up enamel paint for fiberglass stocks.
- Turpentine (white spirits) as general solvent.

Pack down field kit may include:

- Kleen Bore field pack take down rod.
- Bore Snake or basic pull through.
- Mini bottle of copper solvent.
- Mini bottle of lube/barrier oil (or solvent + lube/barrier multi- purpose solution).
- 4x2 cloth.
- Scope lens brush (or LensPen).
- Scope lens cleaning cloth (microfiber).

Please note: CRC Long Life is often labelled and sold using its basic code name CRC SP-350.

CRC Soft Seal is commonly sold under the basic code name CRC SP-400.

Step 1 - Inspect the bore

More often than not folk tend to view the new rifle as having a perfect bore. After all - it's a new rifle, right? Following on from this the trigger is adjusted, the rifle may even be bedded immediately without any thought given to the bore.

Whether buying new or second hand, the bore is the first area that needs detailed inspection. If you are able to view the rifle at a gun store you will have an opportunity to inspect before you buy. Others like myself, who live a long way from the city, may receive their rifles by courier or in my case from clients.

The first step is to remove the bolt and clean the bore with a dry rag. We will talk about bore cleaning in more detail later. But at this stage all we want to do is remove dust. You will need a magnifying glass for this; and a good way to obtain a magnifying glass without a trip to town is to dismantle that cheap Chinese scope you were always suspicious of.

Unscrew the front objective lens and you will have finally put that optic to good use.

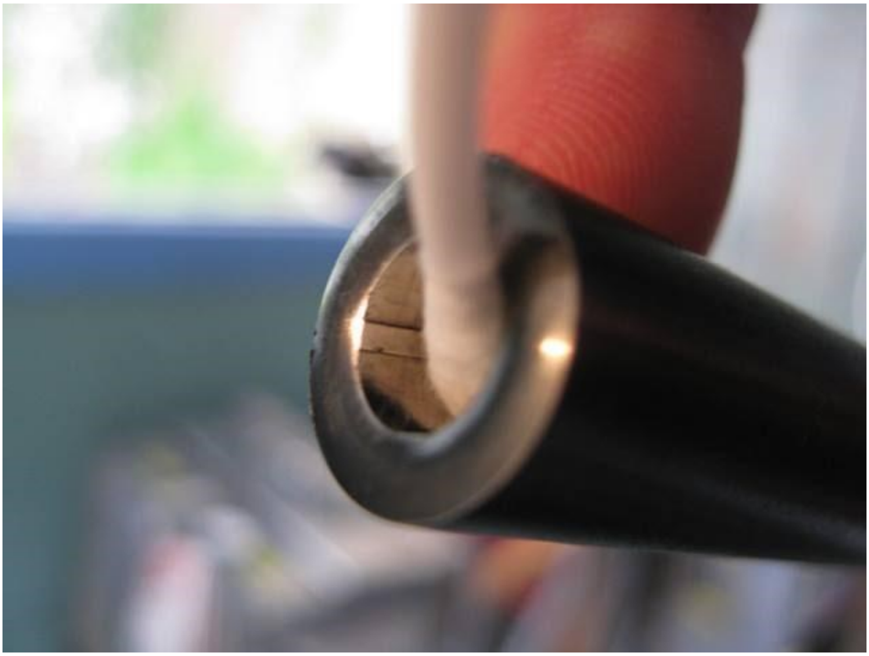
Those of you who can afford to, may wish to purchase a borescope for bore inspection however many of you will simply find this tool too expensive. To this end, some form of basic aid such as a magnifying glass will enable us to observe the muzzle and a portion of the bore, allowing us to obtain a basic understanding of muzzle and bore condition. Some folk use macro settings on their cameras which can also prove very useful, provided pictures are clear and sharp. You can also use a cotton bud to help reflect light of the plastic stem into the bore.

With some sort of magnifying glass in hand take the rifle outside into the daylight, place the butt pad of the rifle on the ground and inspect the muzzle from a 30-45 degree angle. If you live in a built up area with nosey neighbors, I must warn you that it is inappropriate to put on a sad face and yell “BANG” when looking down the muzzle - as it is to follow on with “dang, I missed”.

You may find it easier to go down onto one knee during inspection. With the rifle upright very slowly rotate the barrel and inspect the muzzle, looking for burrs or dents at the very intersection of the muzzle and bore - the chamfered area called the crown. Any burrs at the outer edge of the chamfer are not of great importance but a dent may indicate swelling at the intersection of the chamfer and bore. If the rifle is a recessed target crown, it may not have a chamfer. In this instance simply check to make sure that the very edge of the muzzle is crisp and without dents or burrs.

If light conditions are poor, a cotton bud inserted into the muzzle can help while looking for circumferential burrs within the bore. These are often called chatter marks or button chatter, and I have used these terms myself in the past, but it is actually a gun drill that creates these burrs. A gun drill is used to drill the bore prior to rifling. If the drill does

not clear its swath, the swath is spun around the bore. This is very common these days.



Inspecting a muzzle using a cotton bud to reflect light. Note the chipped land at 9 o'clock.

On second hand chrome moly barreled rifles look for rust pitting, especially at the intersection of lands and grooves. You may have to remove copper before such examinations.

If the muzzle/crown of your rifle is burred or dented it will need recrowning, and the rifle will need to be taken to your gun store if it has a warranty. Failing this, the rifle can be taken to a gunsmith or regular machine shop provided you are able to clearly explain what is required. Very light burrs can be polished out during the break in period. It is also possible to lightly buff the crown with a 6 mm/¼" end grinder, but this is a task for those with engineering experience and a very steady hand.

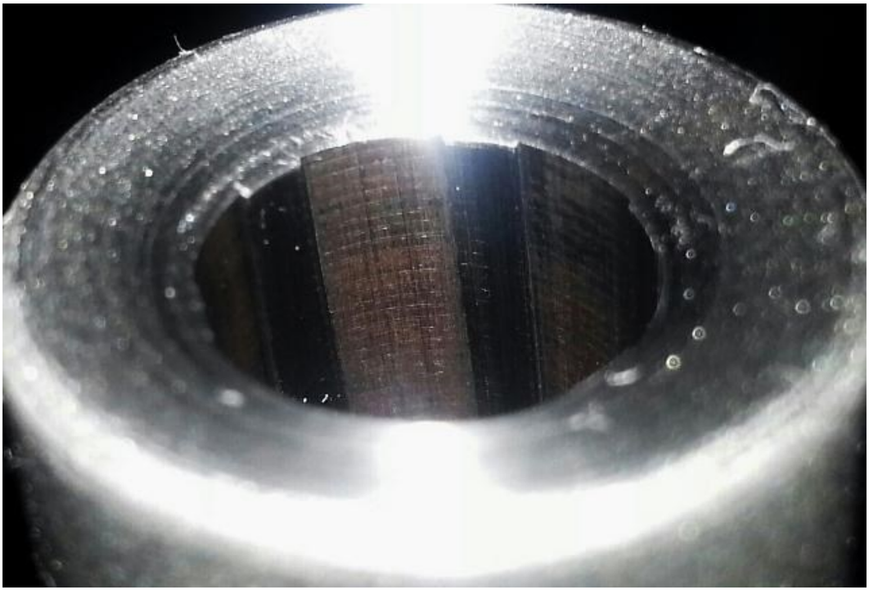
Nowadays companies manufacture DIY type muzzle crowning tools which can be run on a drill without the need for a lathe. Many professional gunsmiths prefer to use a lathe and tool post for muzzle crowning operations to obtain a perfectly true crown which also negates the need for specific tooling and pilots. Piloted crowning tools can also be troublesome during mass production if swath enters the bore, the swath on the pilot gouging the bore. Nevertheless, the DIY user can find comfort in knowing that piloted crowning tools are readily available. So long as a degree of care is taken during crowning operations, the DIY operator can achieve an optimum result. Dave Manson, owner of Manson Reamers currently produce a full DIY crowning kit with instruction booklet and video support.

If the bore is showing circumferential burrs, these will need lapping. Some may appear very shiny and sharp. It is important to understand that some circumferential burrs may have been made by a piloted crowning tool in the hands of a lax operator, the pilot not cleared of swath during mass production. These burrs tend to be somewhat random in nature to a depth of one inch (the length of the pilot guide on the crowning tool which extends into the bore to keep the tool centered). Gun drill burrs tend to be more uniform and extend through the full length of the bore. In some instances, burrs from the use of piloted crowning tools can be so deep as to necessitate removing the last inch of the barrel and re-crowning.

The above rifle shows burrs from the pilot of a crowning tool in the hands of a poor operator. Note the Z shaped burrs.

At this stage we have completed an initial inspection and decided on whether the barrel needs re-crowning or docking and re-crowning.

If the bore has circumferential burrs, these will need lapping which we can address during the barrel break in phase. In some instances, if the burrs are pronounced, it can pay to approach your gun store and have the rifle replaced under warranty. Since my first book several readers have sent factory rifles back for replacement under warranty. This is very good because it helps raise industry standards via customer expectations.



Circumferential gun drill burrs (worm skin).

Circumferential burrs pose the potential for heavy fouling and poor accuracy so we will simply have to work through this as best we can. At this point, if we have decided to persist with the rifle, we place no expectations on the bore; a simple case of “let’s see what happens”.

If the bore has rust pits, the barrel needs to be pulled and replaced before going any further.

As mentioned, a borescope can be very useful but in many instances is beyond the financial reach of hunters. The current market leader at this time of writing is the Hawkeye Borescope which retails at around U.S $700. Cheaper Chinese endoscope units are gradually becoming more readily available but few have the necessary small tube diameter for rifle barrels while fewer still offer any serious degree of optical clarity. Nevertheless, optical clarity of Chinese units may come a little closer to that produced by the Hawkeye unit over time. Until such time, I would

recommend the Hawkeye Borescope as being the benchmark for borescope quality.

One of the key concepts of this book is to help the DIY user without need of expensive items if he cannot afford them. I can think of nothing worse than a book which demands that you own an entire gunsmithing operation to shoot a rifle. It is important that we try to keep this simple. Furthermore, there are times when minor flaws within the bore can instill unnecessary panic. For example, a heavy burr at a mid-point within the bore may prove to be entirely harmless with no negative effect on accuracy once its edges have been smoothed. Yet the man armed with a borescope may see this burr as being the sole cause of accuracy problems with his rifle. I have seen examples of this first hand. Another comment that is often made is “I purchased a borescope for an inaccurate rifle and discovered that my cleaning regime was at fault, the bore suffering from severe copper fouling”. Again, I hope that this book will teach you solid cleaning methods that will prevent such occurrences from happening. Yes, a borescope is very useful - but I do not wish to see the reader feeling that his work will be fruitless without one.

Summary of Key Points:

- Remove the bolt and inspect the bore and muzzle.
- Consider warranty options if bore is rough.
- If there is no warranty (or poor warranty), lap bore during barrel break in process.
- If the bore has rust pits (second hand rifle etc.), it may need immediate replacement.

Step 2 - Inspect locking lugs

First up, we need to be clear about the definition because folk have been caught out with this in the past. The word lug is used to describe two completely different parts of your rifle. The recoil lug is at the bottom of the action or floating in the stock. The bolt locking lugs are located at the head of your bolt. These lock the bolt into place when you close the action, supporting the cartridge during ignition. Book one covered the importance of locking lug alignment. Now we will address the nuts and bolts.

One of the very first things we need to check is that the bolt can be fully closed. You might think this would be a given, but occasionally the bolt handle recess in a rifle stock may not be scalloped enough, especially when adopting aftermarket stocks. This will prevent the bolt handle from coming down fully, thereby preventing the locking lugs fully locking in place. It is therefore very important to check that the root of the bolt handle contacts the metal work of the action and is not hindered by the stock. Any interfering stock material should be removed. If the rifle is a sporterized military bolt action, it may have a poorly re-shaped bolt handle after being altered for scope use. In these cases the bolt handle may need reworking by a gunsmith, rather than scalloping out large amounts of stock material. Following this check (and possibly modifications), you can then move on to inspect locking lug alignment.

Take a marker pen and color the rear faces of your locking lugs - not the front faces! Next, fit the bolt into the rifle and cycle the bolt up and down. If engagement is poor, you may wish to use a fired cartridge shell or new shell with a shim of cellotape on the case head to take up slack. Work the bolt up and down about three times, remove the bolt, and inspect the marker pen. If the pen has been removed from both lugs across a good 80% of the surface area, all is well. If you have a blue

printed action, the lugs should already be showing this contact - unless it is a highly unlikely case of an apprentice skipping this step.

If only one lug is touching, the lug that is touching will need lapping to bring it back, so that both lugs contact.

Checking the bolt locking lugs of a Winchester M70.

Please note, the ahead lapping instructions can only be utilized with modern sporting rifles. Military rifles of the First and Second World Wars often utilized case hardened mild grade steels. If this hardened outer layer of steel is removed, the strength of the lugs will be compromised and could easily result in action failure. Do not lap Mauser bolt locking lugs! A Mauser with uneven lugs should be taken to an established gunsmithing shop. If you make the mistake of lapping Mauser lugs, again take the bolt to an older established machine/smith shop. The bolt head can then be case hardened in Kasenit brand compound. With that warning established, let's move on.

You'll need to either buy valve grinding compound from an engineer supply shop, or visit an engine re-conditioner workshop and ask for two or three pea sized blobs of valve grinding compound (you'll need some sort of container for these). The grades you need are medium and fine. A course grade can also be useful if the locking lugs are way out of alignment. I make my own paste using aluminum oxide buff grit as used within the stainless steel polishing industry. This is the same grit I use for fire lapping. To make my lapping paste, I mix a pinch of buff grit with a drop of motor oil. I generally start with 240 grit (a medium grade) followed by a jump to 600 grit (fine). I will however drop down to 180 grit (course) if I feel that I am getting nowhere with 240 grit.

Once you have your lapping compound, apply the compound to the lug which had the marker pen wiped off. You will probably want to sit down for this job, placing the rifle across your lap, we are lapping after all! Put the bolt in the rifle, push the bolt hard forwards as you close it, then pull back gently and work the bolt up and down about 40-60 times. If you're nosey neighbor is still watching and can just see you through a window, put a poster of a pretty girl up in front of you as you do this. Take the bolt out, clean everything, re-mark the lugs with marker pen and check for contact. If more cutting is required, keep going.

A fired case or new case with a shim of tape can be used to keep the lugs square to the action during lapping. This is especially useful when lapping Remington lugs as the main sear of the trigger has a tendency to push the bolt body off center. If the fit of the case is too tight, you will feel and hear the lapping compound graunch which is altogether too aggressive. The fit of the case needs to be neither too loose nor too tight.

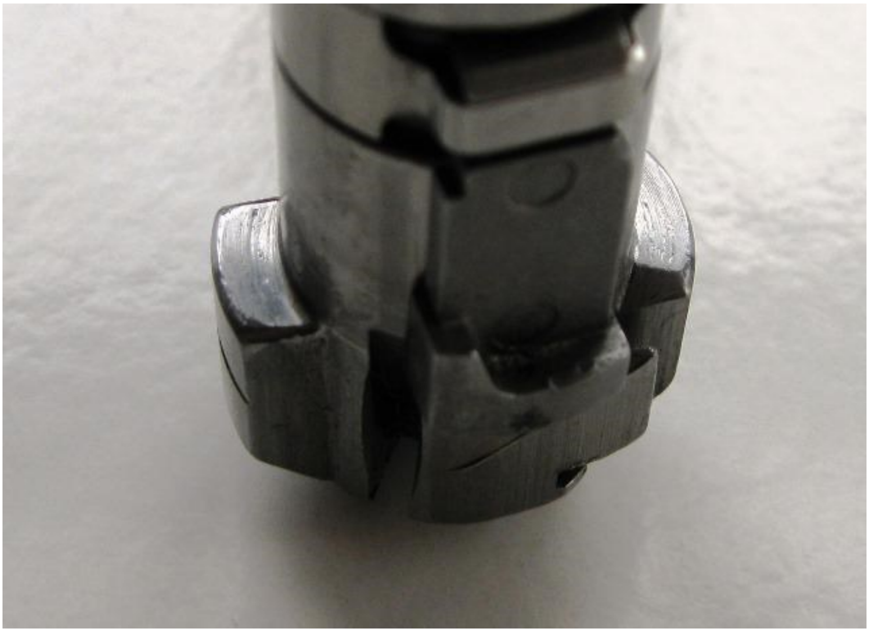
Lapping compound applied with a toothpick.

Now a very important note: Try to keep the rest of the bolt and action clean. Don't allow the paste to loosen other tolerances, such as the bolt head diameter. Each time you remove the bolt, clean everything. You can use brake cleaner, CRC, kero, diesel - whatever takes your fancy; just keep the parts clean including the cartridge case.

You must also be very careful of picking up existing burrs - a common problem. If you pick up (raise) a burr, you'll feel a graunch on the bolt handle. If this occurs, remove the empty case and go straight to fine lapping compound to wear down the sharp edges of the burr without ripping up the lug or lug rebate any further. After fining down the burr, you will be able to resume lapping with medium (240) grit. When lapping, use your eyes (look for burrs on the lugs), your ears (listen for graunching sounds) and your hands (feel for changes in resistance).

If the difference between the lugs is pronounced, you could end up working the bolt up and down for over an hour; the girl in that poster wasn’t so pretty after all.

When the marker pen finally starts to rub off the opposing lug, apply the fine 600 grit paste to both lugs and finish the job with a fine lap.



The lugs are now lapped. Note the burr grooves - these occurred prior to lapping during previous usage. The minor grooves are for the most part inconsequential.

Don't worry about headspace - provided you have not removed any great amount of material. As long as you neck size, this will take up any slack. It is no different to fire forming a wildcat.

If too much material is removed, other factors besides potential headspace issues can also come into play. On Remington actions primary extraction can be affected, the bolt losing its ability to cam

cases out of the chamber. Minimum lug length for the M700 needs to be around 11.15 mm. As we go shorter, we run the risk of primary extraction problems. If this happens the bolt handle will need to be removed and re-soldered in a new position for more camming power. Fortunately the Remington’s are usually pretty close with only light lapping required; some years they are on the money, as is, from the factory. Howa and Ruger tend to be the worst but do not suffer any problems from material removal besides increased headspace. I have yet to see a situation where headspace was increased to the point of the barrel needing to be set back on Howa, Winchester, Remington or Ruger actions. I have seen one Sako AV that suffered excessive headspace after requiring severe lapping.

The current Tikkas and Sakos tend to show near 100% lug contact and usually do not need lapping (though it still pays to check as exceptions do occur). The multiple lug Weatherbys tend to have “a bunch” of lugs contacting their rebates, making lapping less critical.

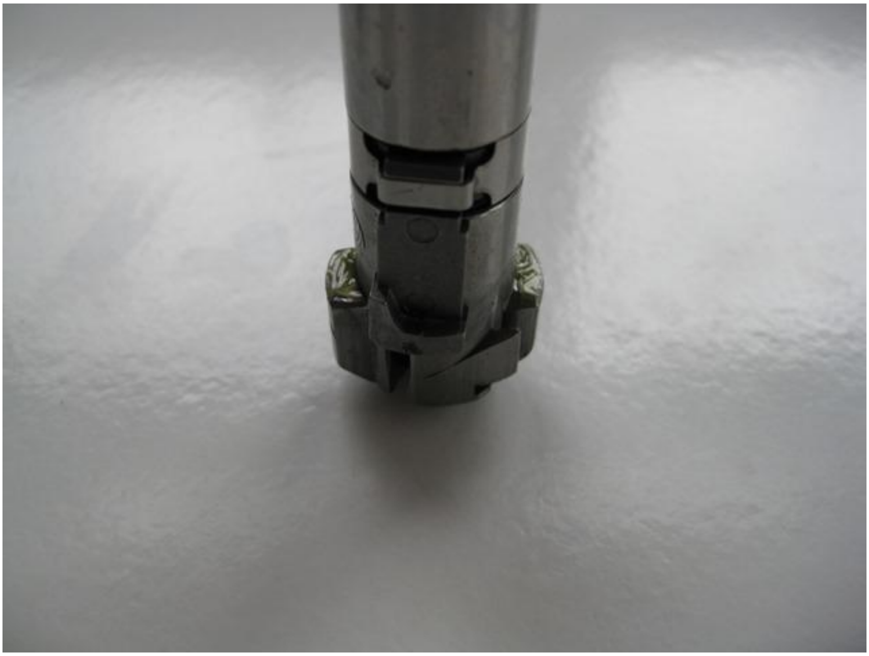
On Winchester actions the safety can become inoperable after lapping. It is quite common. This is not too difficult to rectify but is possibly a job for a gunsmith - for those who are nervous about such tasks. The safety cam lobe needs to be polished just a touch to allow for the new positioning of the lugs. Never try to yank a Winchester (or Montana) safety if the safety becomes stiff!

A burr on the safety cam lobe of a Montana rifle bolt (M70 is the same) showing where the safety lever is catching. Provided the lobe angle is not changed, the lobe face can be honed and polished to the depth of the burr, alleviating further wear while also minimizing the risk of a parts breakage in the future. If no burr is evident but the safety lever is inoperable, carefully remove lobe material one step at a time, employing multiple trial fits.

Above all, if you have any doubt as to your abilities to inspect and lap your bolt locking lugs, take the job to a gunsmith. You can do the marker pen inspection yourself and then send the job off to a professional.

Once the lugs are evenly contacting their rebates make sure the action is free of grit by flushing the action with a bulk solvent. The Bolt will also need thorough cleaning. Following this, apply a light coating of thin protective oil such as CRC Long Life or regular gun oil to both the bolt

body and inner action, wiping away all surplus. The final step is to apply a touch of Lanolin grease or common lithium axle grease to the rear of the lugs, fit the bolt and cycle the action. If you do not apply grease you may notice that the action makes a horrible squeaking noise when cycled. Grease is the fix, just enough to provide ongoing lubrication. Clean off any surplus and also check the lugs after each shooting/cleaning session to make sure the lugs remain lubed. Grease is going to be one your best friends as a rifle owner.



The lugs are now greased. The bolt can now be fitted to the action and cycled a few times. Following this, the bolt can be removed, the lugs inspected one last time, wiping away any surplus grease that has migrated away from the rear faces of lugs.

Summary of Key Points:

- Use marker pen to inspect locking lugs for even contact so that the bolt face is square to the bore.
- Do not lap lugs on older military or vintage rifle designs - seek help from a gunsmith.
- When hand lapping, apply paste to the shiny lug - not the lug which has marker pen remaining.
- Headspace will be increased.

Step 3 - Disassemble rifle, inspect and adjust trigger

Factory rifle triggers are usually set to between 4 and 7lb with good reason - the potential for human error. This is more than simply a matter of litigation. Nobody wants to live with a fatal accident on their conscience. Traditionally gunsmiths are then tasked with customizing triggers to client requirements. Most people don't appreciate the fact that gunsmiths often feel very vulnerable when it comes to trigger work. The smith knows that the client needs a good trigger to shoot well, but also knows that if the rifle is misused, the results could be fatal. The best the smith can do is make peace with the fact that rifles are lethal tools, no matter what the trigger setting. When all is said and done, it is the person holding the rifle that decides where the rifle is pointed. In New Zealand our Arms Code explicitly states that a rifle must be pointed in a safe direction at all times. There is no room for creative legal interpretation of this requirement. The law is immediately broken when the barrel is facing another person, building or vehicle, not when the hand goes to the trigger.

Triggers are the one area I am loathe to write about in detail due to the potential dangers of light triggers and variations in designs. Besides, I

would have to dedicate an entire book to the subject if we were to cover the tuning of each trigger design. To this end, I will simply supply some basic notes of use.

I like to set my triggers at 1.5lbs and I teach my clients to shoot at 1.5lbs for long range precision shooting. I use a trigger scale of a very reputable brand - which is made in China. At 1.5lbs the trigger can just be felt, the finger rested gently on the trigger. Any lighter and we will not be able to feel the trigger in sub-zero temperatures. Any heavier and we might pull shots at longer ranges. The trigger is treated as dangerous at all times, the finger only moves to the trigger once we are on target. Always watch out for folk who keep a finger within the trigger guard when not in a shooting position and don’t be shy to give them a good dressing down it may save a life.

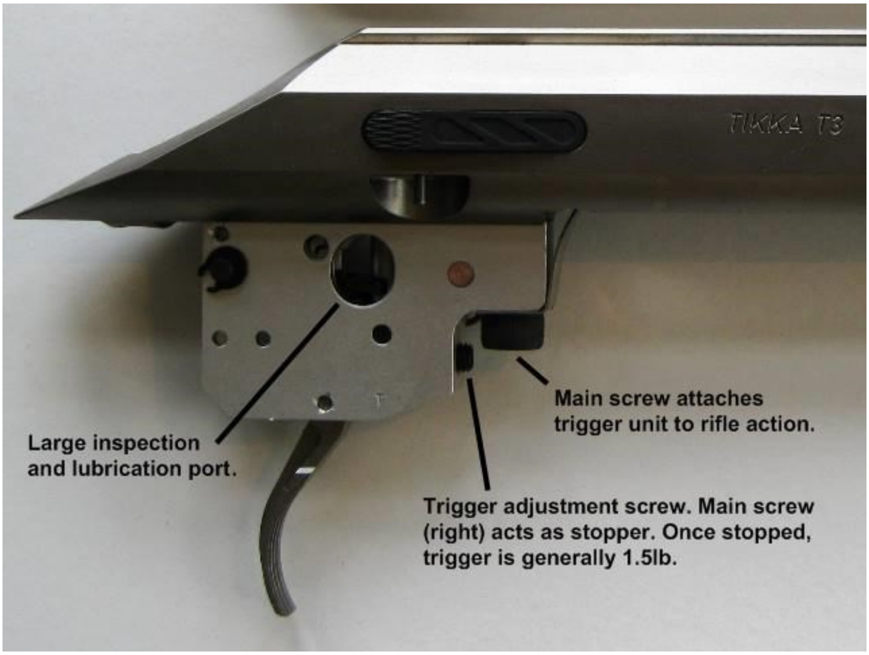
We can divide triggers into three types: fully adjustable for both trigger weight and creep (sear engagement), partially adjustable (trigger weight only), and non-adjustable like the Ruger M77 Mk2 and older Savage rifles. Many fully adjustable triggers also have an adjustment for trigger over travel, discussed further ahead.

Some brands of trigger have a good range of weight adjustment while others have a range of adjustment that will get you part of the way but not all the way to 1.5lbs for precision shooting. Limitations within a trigger design can include a heavy trigger spring that prevents fine tuning, the angle of the sears or excessive creep due to sear over engagement with no facility for adjustment.

You will often hear folk say that they polished a trigger and that it came right after this fine polishing. But more often than not, what really occurs is that the operator has changed the sear angles during honing as opposed to reducing friction. The trouble with this is that some trigger sears are made from very cheap metals with a hard outer layer. Once the hard outer layer is removed the material underneath is prone to

wear and therefore may become dangerous. But often the angle of sears do need changing, there is nothing else for it. I still do not trust the metallurgy of the Remington X-Pro trigger one hundred percent in this regard.

Tikka and Sako currently have about the best trigger on the market. The trigger spring can simply be wound out until it can go no further (touching the opposing M6 Hex head screw), which places the trigger at 1.5lbs. As suggested, Sako use the same unit as Tikka, the previous AV triggers were also relatively straight forwards to work with. It is rare to come across a creepy Sako or Tikka trigger (current design). But if it does occur the trigger sear must be honed (material removed) until the engagement is minimal yet safe, so that it is not prone to discharge if the rifle is dropped or bumped.

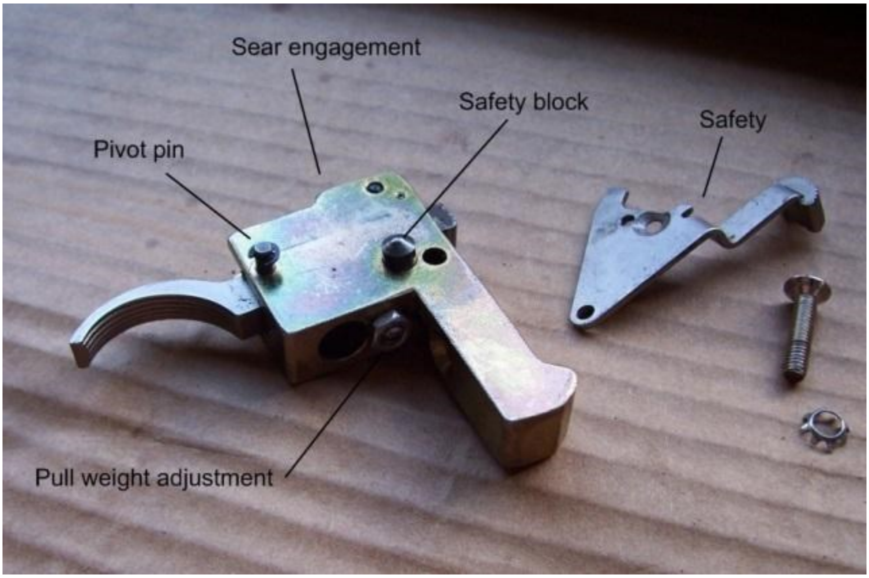


The current Sako/Tikka trigger unit, an excellent design. That said, I highly recommend removing the entire unit (see main assembly screw) and painting grease between the aluminum trigger housing and action to prevent any galvanic reaction. This should be done regardless of whether or not the unit is anodized. Apply loctite to main screw prior to reassembly. Minimum torque setting 45 inch-lbs.

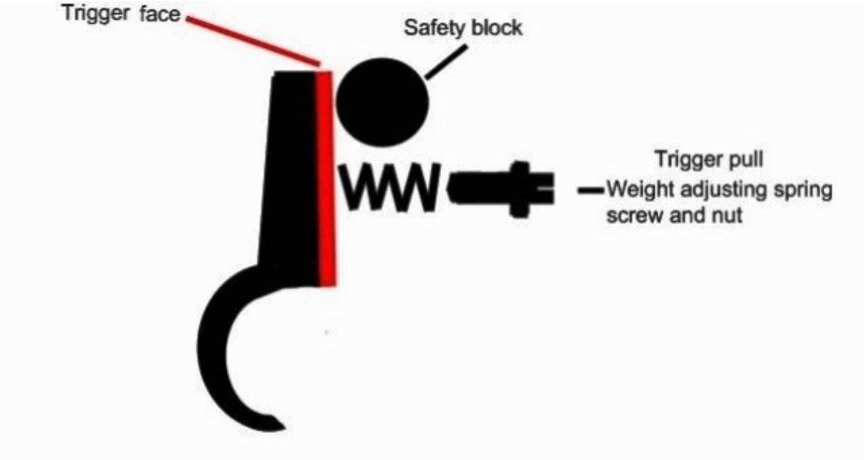
The current Ruger M77 triggers usually have very little creep. The weight can be reduced by simply compressing the trigger spring very carefully with a set of polygrips (use a length of cotton wound onto springs to prevent the spring flying away during manipulation). Older Ruger rifles did sometimes suffer creep, as I am sure still happens on occasion. In these cases the trigger needs honing; and again, caution is required to ensure the unit is safe and will not discharge if the rifle is bumped.

The very simple but non-adjustable Ruger M77 trigger unit. Fortunately this unit can be modified to perfection.

The original Howa trigger can be adjusted to 1.5lbs, but once this is achieved the front face of the trigger must be honed to allow the safety block to operate. This must be done one step at a time; regularly checking the fit to ensure that the safety contacts the trigger face securely without any play, which would allow the rifle to be fired in the safe position.

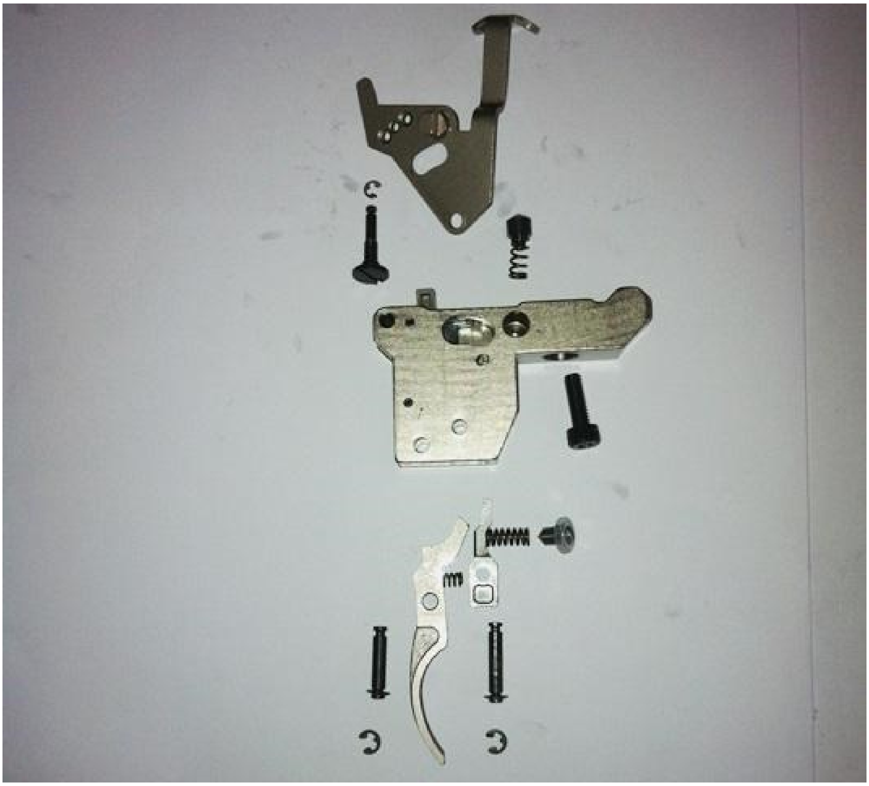


The original Howa M1500 Trigger. Be very careful when handling the circlips (see pivot pin): you'll shed a few tears if you lose one of those babies.

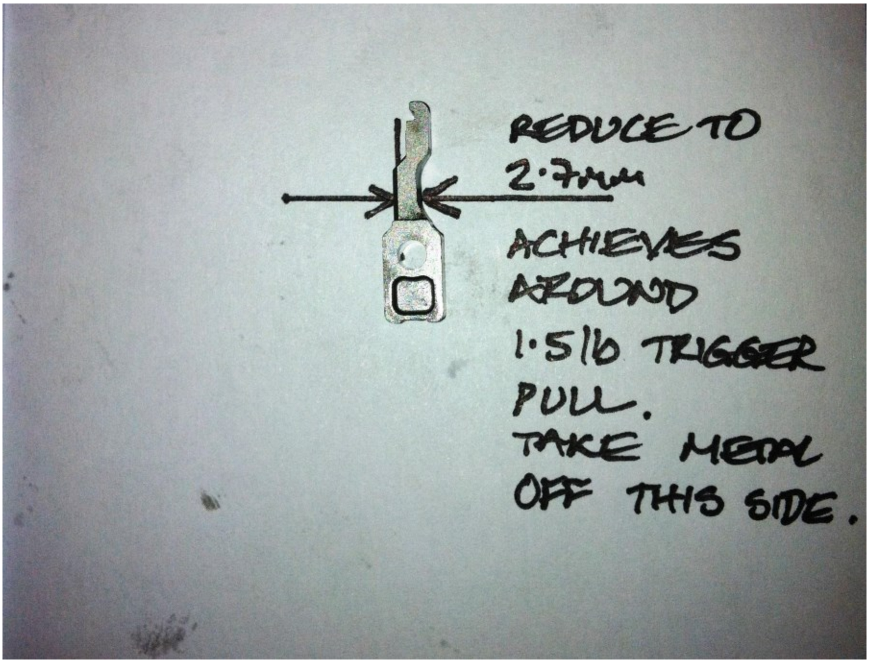


Eat your heart out Da Vinci! My masterpiece, showing the relationship of the Howa safety cross block and the trigger.

The new two stage Howa HACT trigger has a somewhat heavy second stage spring. The crude fix is the same as for the old Remington M700 unit, in which the spring is cut back one winding, then stretched. I cannot condone this practice; as such an undertaking can easily go wrong and compromise the safe operation of the trigger. I have yet to find a suitable aftermarket spring for the new Howa however I have no doubt that something can be found to suit, either now or with eventual aftermarket spring designs.



Howa's new HACT two stage trigger.



Without a readily available aftermarket spring, this DIY operator chose to grind the front face of the trigger (see right arrow). I cannot condone this practice, however the photo shows the extent that trigger tinkering can be taken to. The result in this instance was complete success.

The original Winchester triggers are generally straight forwards to adjust and/or hone. This was a simple factory trigger that could be set both light and crisp - a joy to use. I have however been beaten by one M70, which would not allow me to decrease weight or creep in a safe manner. I honed the creep from the sears. But as I decreased weight the trigger became unsafe, forcing me to increase trigger weight to around 2.5lbs; adequate for general hunting but not ideal for long range work. Fortunately, there are aftermarket Timney triggers for the M70 action.

The original Winchester M70 trigger unit, a simple and effective trigger design. I have used 5 minute epoxy (medium strength) to lock my settings, a blob on each nut. This epoxy will be easy to remove later if need be.

The new M70 MOA trigger unit found on the Winchester Extreme series rifles tends to be set at around 4lbs at the factory and is adjustable down to around 3lbs. There are aftermarket springs available, which take the pull weight down to around 2.5lbs; a safer option than the cut and stretch trick. Better still, Timney now make a complete replacement unit for the Extreme rifle which can be adjusted down to 1.5lbs for precision shooting.

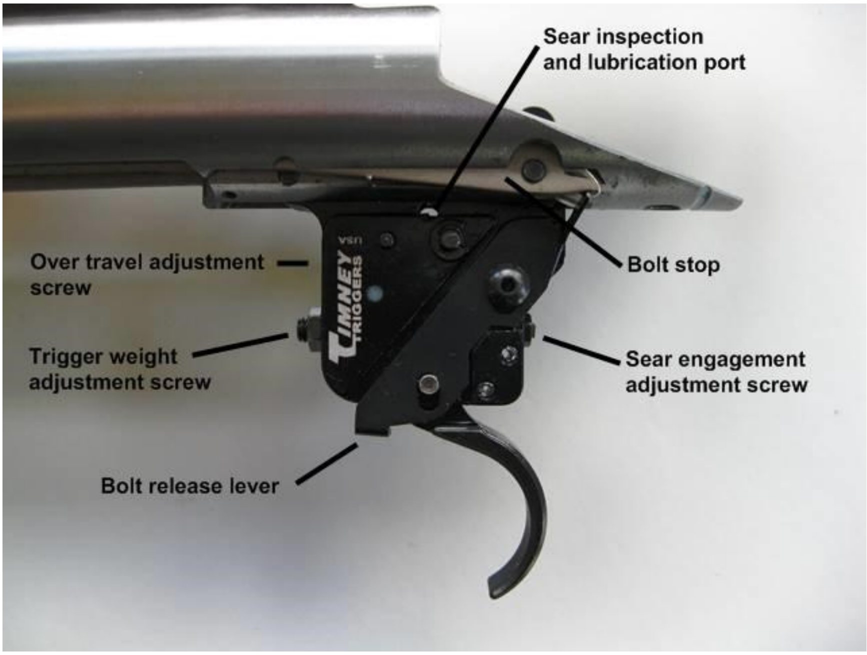
The original Remington M700 trigger was a good unit but it had two basic limitations: the 3lbs limit being one, and sear engagement or creep being the second. In some instances the sear engagement screw (located at the rear of the unit) is frozen due to a hefty application of

thread locker. In most cases heat (steam or heat gun) is enough to loosen the thread locker, allowing the engagement to be adjusted. That said, the occasional hex head screw will strip, preventing removal. In these instances the creep can be honed out of the trigger sear. As previously suggested, to get below 3lbs the trigger spring had to be cut and stretched (not a recommended practice) or preferably (especially from a safety perspective) replaced with an aftermarket spring. The result of the right care and attention: a good trigger unit! Why Remington felt the need to change this trigger, I will never know. But with the advent of the M700 SPS rifle came a new trigger. This was soon adopted on all models of the M700 line bar the M24 sniper rifles and 40-X custom shop rifles, which still feature the 40-X trigger. In an ideal world the 40-X trigger should be a stock item on all M700 rifles, especially those of the Sendero series.

The Modern Remington M700 X-Pro trigger can sometimes be modified and adjusted to a light weight, but I advise readers to refrain against any sear modifications. If such modifications are required, bin the trigger and replace it with an aftermarket unit.

Those of you who simply wish to experiment with making the X-Pro trigger lighter within its adjustment range will find that the X-Pro trigger can be taken down to between 3-4lbs via the adjustment screw that passes through the trigger. A further decrease in weight can be gained via the traditional trigger weight adjustment screw at the front of the trigger unit. Providing the sear angles do not interfere with potential, setting the traditional adjustment screw to a lighter setting while ensuring its trigger spring remains positively engaged, can bring the X-Pro trigger down to between 1.6 and 2lbs.

A Remington X-Pro trigger sear. Note how the sear is angled up (top right). This angle prevents the trigger from being adjusted to a light weight because the sear remains constantly loaded. The remedy is to square off the sear. However, I do not trust the metallurgy of this trigger unit and advise both professionals and DIY users to exercise extreme caution when dealing with X-Pro trigger. If a desirable trigger weight cannot be achieved via the two adjustment screws, replace the trigger.



The Timney trigger, a simple fix for the M700. In my time I have come across only two less than optimal Timney triggers. Both were taken back and replaced - no questions asked. Jewell is another excellent aftermarket brand, perhaps the pinnacle of trigger engineering as far as the M700 and its clones are concerned.

The Savage Accutrigger is somewhat like the Howa HACT trigger, in that the second stage spring weight can be heavy. Savage use a budget method of assembly, whereby the trigger unit is thread tapped, the spring is then wound into the trigger unit, the coils of the spring acting as threads. A specialized tool can be used to rotate the spring deeper into the trigger unit as a means to decrease trigger weight. However, the last time I attempted this, the spring splayed as I turned it and became miss-shaped. But rather than wait for a replacement part I simply fitted a headless screw to the block, then fitted a coil spring over the headless screw - job done, 1.5 lbs. This is yet another job that I

cannot condone for reasons of safety. A far better solution for a problem Accutrigger is the installation of a Timney unit.

Thoughts on trigger tinkering

I have seen new shooters with a mechanical background purchase a budget rifle and modify a non-adjustable trigger to perfection. By the same token, I have seen highly experienced target shooters with poor mechanical aptitude take an already fully adjustable Tikka trigger and completely ruin the unit through tinkering.

So, here are my thoughts: To begin with, investigate aftermarket triggers. Companies like Timney now make a huge range of triggers, far more than ever before. There is simply no need to bust a boiler with these options available.

If you lack mechanical skills, purchase a rifle which has either a fully adjustable trigger or a rifle which is supported by aftermarket triggers.

If you have mechanical skills, you may wish to try and fine tune your trigger. You will need to learn to discern between weight that is related to sear loading versus spring weight. If the sears are at poor angles, you will find that you can completely remove the trigger springs and the trigger weight is still up around 3-4lbs.

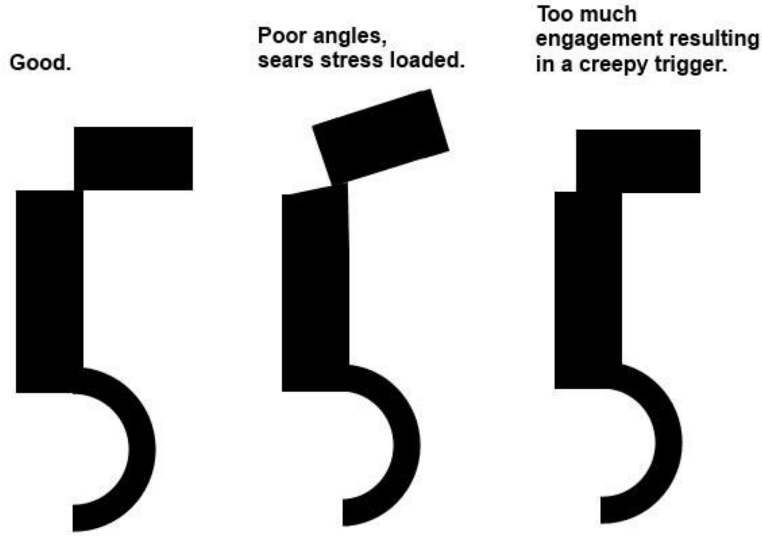


Diagram showing trigger sear and main sear engagement.

If there is the slightest doubt, have a gunsmith modify or replace your trigger.

If you decide to modify your existing trigger, make sure the trigger sears are well lubricated when performing tests. If you do take your dry trigger on a one way trip to 1.5lbs, you may well find that the actual pull weight comes down to less than 1lb after lubrication, resulting in safety complications. I use a synthetic motor oil to lube trigger sears because of its wide temperature operating range. I normally apply lube with a toothpick or cotton bud, the bud cut off.

To adjust sear angles or engagement (if the unit lacks an engagement screw) I run the sears across a Norton fine grade sharpening stone. Angles are the key factor. If you have any doubt, mark surfaces with marker pen. As you hone, the marker pen will be removed and show up

any mistakes in your angles. I really cannot condone such practices, as it is so very difficult to ensure the safety of DIY modifications; sear metallurgy being another issue. Nevertheless, it perhaps is better to discuss modifications, as no doubt many of you have or will at some point attempt trigger modifications.

Be very careful with trigger springs. The temper of trigger springs is easily removed if they are near to any heat source, and that will obviously ruin the spring. If you choose to utilize the not recommended method of cutting and stretching a spring, you may find yourself wanting to disc the cut end of the spring back to a flat surface. This level of heat can ruin the temper of the spring within seconds, thus extreme caution is required. When handling springs, wrap a good length of sewing cotton into the spring with the other end attached to your thumb or perhaps a piece of bright electrical tape. This will prevent you losing the spring should it ping away or fall to the ground.

When modifying a trigger, you must reassemble the unit and rifle multiple times to check your progress. This can consume hours but it is very important that you do regular checks to make sure that you have not gone too far. Again, ensure the sears are lubed each time you assemble and test the rifle.

A fully adjustable trigger will have an over travel screw. This can be useful, as it limits trigger movement after the trigger sear has disengaged (when the rifle is fired). This has the potential to prevent excessive spring compression, which over an extended period of time could alter trigger weight settings. Pistol and auto rifle shooters may also find that a short over travel has a better feel during rapid fire. On the other hand, if the trigger is not given free movement, the sears may clog with grime or the lubricant may become gummy. In the worst case scenario (if the over travel is set far too short) the main sear may drag down the face of the trigger sear during release, effecting ignition. So, a

degree of movement is needed, and the trigger sear should fully clear the main sear by a good margin during testing. Fortunately, factory settings are generally good, so there should be no need to tinker with over travel.

Once assembled, try fast cycling the action (on an empty chamber) to make sure that the sears engage. If they don't, the firing pin will move forwards during cycling and may detonate a cartridge primer before the bolt is locked home (slam fire). You will need to observe the rear of the bolt shroud to see if the firing pin spring (mainspring) is disengaging. Cycle the action as fast as possible. If the rifle is dry slam firing, the trigger weight or sear engagement will need readjusting. Due to the differences in harmonic vibrations it is important that you do your fast cycle testing with the rifle fully assembled as opposed to holding the barreled action in one hand.

Next, drop test the rifle. Cock the rifle on an empty chamber, and drop the rifle on its butt from a few inches off the ground. Listen to check if the rifle dry fires. You may also be able to observe the rear of the firing pin mechanism, whether it remains protruding from the rear of the bolt shroud or whether it falls to the fired position. Do this test several times, steadily increasing the height to a distance you are comfortable with - normally around 12". Do this test properly as there is always a risk that vibrations (like falling over in the field) could set off the rifle if the sears are not safely engaged.

Following the above, test the safety. Cock the rifle on an empty chamber, put the safety on, and pull the trigger firmly. Release the safety, reapply the safety, drop test with safety on, drop test with safety off. Repeatedly test everything until you are 100% sure about the safety operation of your rifle.

Once you have your trigger set, coat the tips of the exposed screws with nail polish, allowing the polish to run onto the trigger housing. 5 minute

epoxy can also be used, but not with recessed screws or where there is any doubt about epoxy removal. Whichever you use, the product should lock the set screws in place but be laid in such a way that it can easily be peeled away and removed if necessary without damaging threads or screw heads. The purpose of this step is to prevent the set screws from unwinding (vibrations) when in the field. Once the varnish or epoxy has set hard, a light lubricant should be applied to the outer housing or metal work of the trigger unit to both lubricate and protect the trigger unit from corrosion.

If you have purchased an aftermarket trigger, you will still need to perform these tests after adjusting the pull weight and or sear engagement.

As a last reminder: once your trigger is set, it is to be considered dangerous at all times! If you injure yourself or another person when using a light but safe and reliable trigger, it is your fault, not the trigger weight. You cannot blame anyone else for the direction you pointed your rifle in or how you handled it. Even if you are using a European single or double set trigger (set to less than 1lb) which could fire simply by bumping the stock, the responsibility is yours alone. Always point your rifle in a safe direction and keep your finger off the trigger until you are on target. Train and drill your children to do the same.

Trigger weight settings are to some extent subjective. I generally prefer a 1.5lbs pull for all of my rifles if possible. This setting is heavy enough to allow me to feel the trigger, even if I have lost some feeling in my trigger finger during cold weather. I can feel the trigger, then apply a light pull to fire the rifle. Those with heavily calloused fingers and crushing grips may prefer a heavier setting. The same may apply for general hunting inside 300 yards. But in either case, I suggest staying right around 2.25lbs with 3lbs as the upper limit.

I have seen a few hunters adopt fairly heavy (4lbs) trigger pulls on heavy caliber rifles (e.g. .375 H&H) with the view that not a great deal of accuracy is needed with such potent chamberings. A word of advice: a lighter trigger makes the medium and big bores a lot easier to shoot by decreasing recoil anticipation. I see it like this: If you are pulling 4lbs, the muscles in your finger, hand and arm are already pulling backwards and to one side. This motion increases exponentially under recoil, pulling the rifle to the right (if right handed) or left (if left handed). The results are quite obvious when making trigger adjustments in the field - no matter how hard we try to train ourselves otherwise. POI shifts laterally, depending on trigger weight. A light trigger (and bedding etc..) can make the medium and big bores more accurate and therefore increase their effective range, in turn increasing the flexibility of the cartridge. Many hunters handicap the medium and big bores by neglecting basic accuracy concerns.

There will of course be times when you cannot obtain 1.5lbs or similarly light settings. You may for example own a Marlin lever action rifle or surplus military rifle that you do not wish to tinker with. This is completely fine. All I am suggesting is that you work towards having your pet bolt action hunting rifles capable of precision work, whether that means taking a neck shot at 50 to 100 yards or dedicated long range shooting.

I would also suggest 1.5lbs for Police tactical units, especially those wishing to get away from area shooting and move towards select shot placement. A tactical assault rifle by my definition means an assault rifle used for accurate select shot placement rather than suppressive advancing fire. These rifles can be fitted with aftermarket two stage match triggers that offer the adrenalized shooter some level of control via the first stage of the trigger pull. Ironically, our last accidental shooting (by a police officer) in New Zealand was with a Bushmaster rifle with a very heavy creepy trigger. The lesson: a heavy creepy trigger

does not make a rifle safe! This is an illusion. A heavy trigger simply interferes with accurate shooting! Training is the key and in this instance, practice with an adrenalized bloodstream. If you want to be an effective police officer - learn to love guns. These are the modern tools for those endowed with hunter and/or warrior/protector genetics. The more you learn to love your tools, the more effective and safe you will be.

While I am aware that 3lbs has been the standard setting for military sniper rifles over the years, I would still recommend a 1.5lbs setting (single stage) for all operators. As for the standard military assault rifle, I am not too happy with some of the triggers I have seen of late. I have seen better triggers on old Winchester 92 and 94 rifles, SMLE rifles and Mauser rifles that are now more than a century old. Even the AK and SKS variant rifles sometimes feature better triggers than some of the rifles our western military forces are now required to use. I find this so hard to fathom when a simple two stage trigger, akin to the Savage Accutrigger unit set to 3lbs would be entirely safe and sufficient. Training is the key. If you want to ride well, you have to understand the horse - not fit it with an elevator bit and expect it to miraculously conform to ignorant commands.

Now we have the basic barrel/action set up, the metal work is pretty much ready for field testing, although some of us will have to go through a period of hefty bore lapping.

Summary of Key Points:

- For precision shooting, adjust trigger to a light and crisp setting.
- Check availability of aftermarket triggers for your rifle if your trigger has a poor (or zero) adjustment range.

- Make sure trigger sears are lubed during testing when performing modifications.
- Perform fast cycling (slam fire) and drop (vibration) tests thoroughly.
- Treat all triggers and firearms as dangerous. A heavy trigger does not make a rifle safer - this is just an illusion.

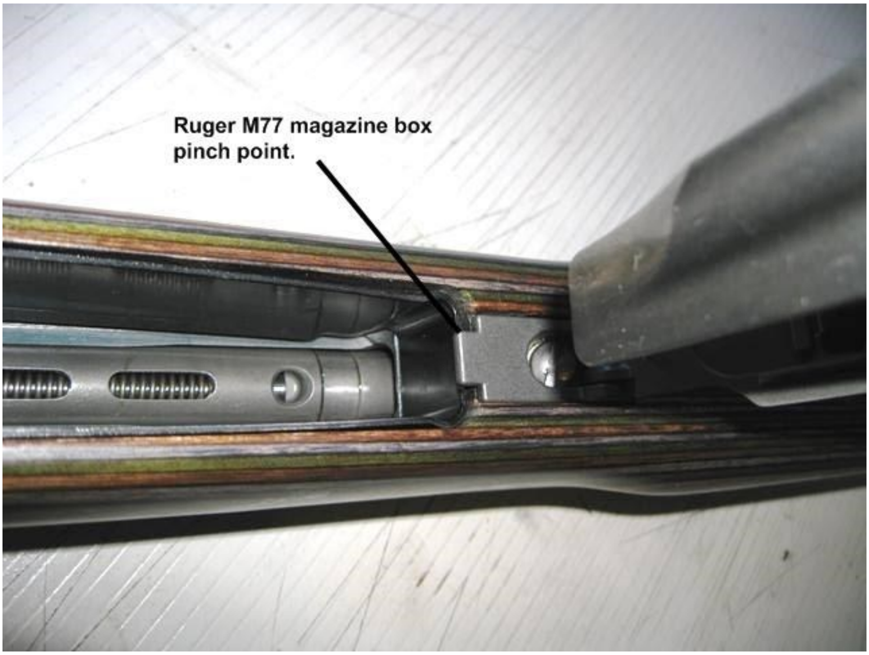
Step 4 - Check fit of action, magazine box and trigger in stock

If the rifle is not going to be bedded from the outset, this step needs to be taken before going any further. If the rifle is to be bedded immediately, we can check the magazine box after bedding.

Rifles with box magazines (as opposed to detachable mags) can suffer pinching of the magazine box. This means that when you do up the action screws, rather than the action coming down to rest in the stock/bedding platform, the action rests on the magazine! This is quite a common problem and can occur as a result of two issues:

- Stock inlet is too low - magazine must be altered slightly.
- Incorrect assembly.

The Ruger M77 is an example of a rifle that commonly suffers magazine pinching. In this instance the magazine box needs altering, utilizing needle files to relieve pinch points.



A typical Ruger pinch point which is easily rectified.

The M700 is an example of a rifle that commonly is assembled incorrectly; the magazine box fitted with a slight side to side cant which gets hung up on the floor plate. On occasion however, the inlet is incorrect and the bottom of the magazine box needs discing - just a touch.

The magazine box needs to be free moving when the rifle is assembled. It should sit somewhat firmly in place; but with the floor plate released (bottom metal still attached), you should be able to wriggle the magazine box with your fingers.

On Mauser actions the magazine box is a part of the floorplate assembly and cannot be wriggled. Instead there needs to be a gap of about .2 to .5 mm (20 thou) clearance at the top of the magazine box where it meets the action. Without this gap the action will be sitting on the

magazine box rather than sitting on the rifle bedding platform. In essence the stock will be flopping around between the rifle action and bottom metal with a terribly negative effect on accuracy. At the same time we need to ensure that the gap between the Mauser magazine box and action is not too large. If there is too much of a gap bullet tips may become wedged in it, as you try to feed cartridges into the chamber.

It is also important to check for high spots in the stock prior to test shooting (unbedded rifles). As an example, a high spot that commonly occurs in both HS and Bell & Carlson stocks, can be found just in front of the bolt handle cut out. Any high spot between the front of the action and tang (i.e. magazine well area) will create stress after assembly and in turn ruin accuracy. You can easily find high spots prior to fitting the action screws by checking if the action seesaws in the stock. It is also important to perform the 1 o'clock test as described in book one.

At this stage, you may also want to check the action for side to side movement within the stock. Ultimately, the action needs to fit the stock correctly before performing any preliminary tests.

We also need to check that the trigger is not touching the trigger guard which could potentially destroy accuracy. On M700 rifles for example, the bottom of the safety lever on Timney triggers can become crushed against the trigger guard. Grinding a small amount of material out of the trigger guard can correct this. Be equally careful of rifles that have just had a trigger design upgrade from the manufacturer without a trigger guard redesign.

One factor to be aware of is that if you intend to bed your rifle, this will invariably affect the resting height of the action, which will in turn affect magazine fit. If for example you have a very tight fitting M700 magazine box, rather than disc or file the magazine box prior to test shooting (including mock bedding), it can pay to leave magazine alterations until after proper epoxy resin bedding. In worst case scenarios (extremely

poor fit), the magazine box and follower can be left out of the rifle during preliminary test shooting. This will allow you to test the rifle and study the bore prior to bedding without the magazine as a variable.

Summary of Key Points:

- Check fit of both magazine box and trigger unit.
- Learn to differentiate between human assembly errors and factory tolerance errors.
- If alterations are required, determine whether these are best done prior to or following epoxy resin bedding.
- Worst case scenario - omit the magazine box and follower during preliminary testing.

Step 5 - Assemble rifle

Upon receiving your rifle you will need to decide whether to bed the rifle or leave it unbedded. If it is a second hand rifle, explore whether the rifle has been bedded previously and if so, whether a re-bed is required (explained in the Practical Guide To Long Range Hunting Rifles). The simplest way for me to explain this to you is to relay my own methods as I receive a client rifle on my bench.

My take on things is that it is not worth putting huge amounts of time into bedding a rifle if the barrel is a dud. To this extent, I want to perform preliminary tests. I need to be able to set the rifle up with minimum labor, yet I also want the rifle potentially accurate for these initial tests. So, my first decision is how to go about bedding after I have given the bore, lugs and trigger a once over.

To begin with, I never shoot a wood stock as is because I believe it is imperative to bed wood stocks to prevent warping or stock compression over time. I generally mock bed a wood stocked rifle for preliminary testing.

With Winchester and Browning rifles (wood or synthetic), I test shoot the rifle as is, due to the factory glue gun bedding being sufficient for preliminary testing. If the rifle shoots well, I can then commence bedding.

With Remington SPS and BDL style rifles, Mauser, Howa, Savage, older Sako rifles and other action designs I mock bed, using either auto body filler or utilize my glue and screw system. Both methods are discussed later in this book.

In gun magazines you will see folk test Remington Mountain style rifles as is, with the factory forend pressure points utilized. This is not my cup of tea, sorry. I want to know how that rifle is going to shoot when the barrel is floated, not pre-loaded. It is at this stage that I part ways with

the warranty and remove the pressure point pads. If the barrel won't shoot straight unless preloaded and stressed, I don't want that barrel. In this case I would not have been able to replace it under warranty anyway.

Rifles with aluminum chassis stocks can be left as is for preliminary testing. That said, ali chassis stocks can easily be mock bedded or glued and screwed.

The Savage Accustock rifle can be left as is; the same goes for the Savage Axis and Ruger American. Both the Axis and American need to be set up in the same manner as the Tikka T3 rifle.

The Tikka T3 factory rifle can be set up ready for field testing without bedding. The set up is however critical, so I will dedicate a section to this, later within in this book.

I can easily understand your wish to jump straight into full epoxy bedding before test shooting. I myself have done a great deal of this in the past. The trouble is: If the barrel is a dud, it is better to find out before investing a great amount of time and money into bedding. Nevertheless, there are times when I have full trust in the components and bed the rifle from the get go, especially if it is a custom build. This really is entirely up to you, there are no wrong decisions in this regard.

Mock bedding

Those of you who have read my first book and online articles will understand that there are two types of bedding we can utilize: bedding that allows the rifle to recoil and return to battery versus rigid mount bedding. Mock bedding utilizes the rigid mount method for temporary testing. Job time should be under 10 minutes.

Firstly, make sure the barrel is free floating by removing any pressure point pads at the tip of the forend. We won't be testing bent barrels today.

The basic premise of my mock bedding method is to fill behind the recoil lug and give support to the sides of the action and the tang. We are not looking for a pretty bedding job. To perform a mock bed utilize a fast curing auto body filler; you may wish to use a fiber reinforced filler on high recoiling rigs.

Please note, if you have a skeletonized plastic stock, it is best to stabilize the stock before mock bedding (see stock stabilizing section). If you do not perform this first step, you will use copious amounts of body filler within the skeletal voids of the stock which will then need to be removed after mock testing, a time consuming and frustrating process. If you are not in a position to stabilize the rifle (perhaps due to testing a second hand rifle that you do not yet own), the simplest means of testing is to utilize the glue and screw method (discussed ahead) on the side walls of the action as a means to mock bed. But to employ this method, the barrel still needs to be free floated (no pressure point bedding). These tricks aside, stabilizing is recommended for best results prior to mock bedding a skeletonized plastic stock.

You will need to paint a release agent onto the action to prevent a permanent bond. CRC Soft Seal can be used for both rust prevention and as a release agent during this process. Kiwi liquid boot polish can also be used as a release agent. Lee wax case sizing lube is another option, so long as it is left to dry properly. Apply the release agent to the action and allow it to fully dry. If you have not used CRC Soft Seal as a release agent and general protective coating, you will need to apply a protective coating to other areas of hidden metal work. In other words, if you use Kiwi wax as a release agent at mock bedding contact points, use grease elsewhere. Next, mix a couple of tablespoons of body filler.

The body filler should be applied to the intersection of the recoil lug and action, building up the area until the entire rear of the lug is covered in filler, forming a triangle down to the action. You can now apply some filler to the stock along the side walls where the action sits. It is up to you whether you apply filler to the tang, a small blob can be useful. It can also pay to apply filler to the start of the barrel channel. But if the stock is skeletonized, you will need to keep the barrel completely free floated, as it is very difficult to use thick fillers in skeletonized rifle stocks.

All of a sudden we are running out of time, as the filler cures; quickly fit the magazine box to the action and insert the barreled action into the stock. Use cotton buds to clear filler from the action screw holes and check for any major seepage between the front of the magazine box and stock inlet.

Once the floor plate is set in place, nip the action screws to a very light torque setting to avoid stressing the action or stock. Once the mortise is cured, you can then set the action screws to a heavier toque setting (see torque setting table).

After approximately one hour the filler will be tough enough to start preliminary testing. Do not try to remove the action from the stock during this phase - otherwise the rigid mount bedding will be ruined!

That's frightening, my 5 minute mock bedding job with auto body filler looks better than many of the pro bedding jobs that hit my bench.

Mock bedding at the tang. This is definitely not a permanent fix; the filler is very weak in comparison to epoxy. But for temporary testing the filler works fine.

After testing the barreled action can be broken away using a striking motion with a mallet as described in the bedding section. The filler should be very easy to remove, as we made no attempt to key into the side walls of the stock during our prep. After removing the filler the rifle should appear as new.

Bedding with auto body filler is not a good permanent bedding solution. Many times I have seen client rifles that were bedded with auto body filler - from days gone by when this was all that was available. Unfortunately, body filler absorbs oils and solvents over time and begins to break down. Sometimes the break down is very fast. Fillers also cannot handle recoil in the way a proper bedding compound can. Mock

bedding with auto body filler is best used as a very short term test method.

On occasion you will find that there are certain brands or models of rifles that you cannot mock bed easily. The Sako 85 is a good example; its chassis system prevents any form of mock bedding in the area of the action. My advice with the Sako 85 is to perform preliminary tests without mock bedding. There are however occasions when the fit of the 85 is so poor that the action and barrel can be wriggled from side to side within the stock. The simplest form of mock bedding in these cases is to bed the start of the barrel channel. A second option is to abandon preliminary testing and move straight to epoxy resin bedding, ditching the entire chassis system and adopting an A7 (Tikka T3) style lug set up.

Mock bedding is also highly useful for establishing how to go about bedding the forend of troublesome rifles with two piece stocks, including the Browning BLR and Ruger No.1. Mock bedding allows us to fully test various approaches including free floating away from mount points, full barrel bedding and pressure point bedding.

Finally, we need to establish goal accuracy with our rough and ready mock bedding. Personally, I look for groups of around 1" if possible. My handloads are very basic: worked up in half grain increments, three shot groups. What I am most interested in is the shape of groups, looking for a triangular configuration. If there is something dreadfully wrong, I will normally see wide fliers or shots strung vertically over 3". Wide double grouping may also indicate a barrel problem (heat treatment/stress). If your mock bed is secure, wide groups are not occurring as a result of your bedding. It is either the bore, low quality handloads, or poor shooting technique that is at fault. Try to make peace with the fact that a good mock bed is sufficient for testing.

Once I have the rifle shooting around 1" groups, I will then set about proper epoxy bedding - knowing that I am not wasting my time.

Summary of Key Points:

- Observe bedding and or fit of rifle and determine whether to utilize mock bedding.
- Utilize mock bedding as a temporary fix for preliminary test procedures as necessary.
- Goal accuracy around 1”. Group shape more important than group size.

Glue it and screw it

Glue and screw is the term I use to describe the use of 5 minute epoxy resin as a means to achieve the rigid mount bedding of a rifle, utilizing the double syringe type epoxies available from supermarkets and hardware stores.

Glue and screw rigid mount bedding can be used in two ways:

1. Mock bedding for testing (same method as auto body filler).
2. Semi-permanent rifle bedding.

In this instance we will discuss the glue and screw method as a semi-permanent bedding solution. On the Accuracy International rifle (especially when mated to the M700 rifle action) as well as on other emerging aluminum chassis designs the use of 5 minute epoxy has the potential to fully optimize accuracy. Accuracy International uses this system when assembling their AW production sniper rifles, so it is nothing new. In cases where the chassis design is not conducive to traditional bedding practices (lacking stock side walls as an example) the glue and screw method is the far better option. As another example, the

chassis may feature multiple lug recesses, as found on the Thompson/Center Icon rifle, thus making traditional bedding extremely difficult. The glue and screw method can also be utilized on the Accuracy International AE economy series rifles, which are not factory assembled utilizing epoxy resin.

It is also possible to glue and screw the Remington Sendero and 5R rifles in a semi-permanent fashion. That said, these rifles are relatively straight forwards to bed (traditional method), making routine maintenance much easier.

Rifles with two piece stocks, such as the Ruger No.1, can also be glued and screwed to eliminate stock movement, after free floating the barrel beyond the mount points. That said, I strongly suggest a full range of experimentation with mock bedding, using auto body filler, before committing to any glue and screw approach.

Both, fast (5 minute) and slow cure high strength epoxies can be used. Slow cure epoxies tend to cure and form a more rigid bond; however, actions bedded in this way can be more difficult to remove. Therefore, action preparation needs to be optimal in these cases (CRC Soft Seal / CRC SP-400 recommended as a release agent).

The upside of rigid mount bedding is that it is a very fast fix and removes all metal to metal vibrations which have a negative effect on accuracy. The downside is that each time the rifle is disassembled for action cleaning, the entire process must be repeated. One cannot simply break down and reassemble a glued and screwed rifle quickly. Time gained with the fast and simple set up process is lost during the cleanup and reapplication process. Nevertheless, in some instances, depending on rifle action design, the glue and screw method is optimal.

With their AW rifle Accuracy International have, whether by deliberate design or as an unintended result of the design, arrived at a

compromise between rigid mount and traditional bedding. Although the action is epoxied to the chassis, the side panels of the stock can be removed, allowing most of the rifle to be cleaned without full dis-assembly. The only area that cannot be cleaned is the bottom of the action, which due to its epoxy bond with the chassis cannot suffer any form of corrosion. The trigger can also be removed separately.

Side view of an Accuracy International AW rifle action, the epoxy seam clearly evident.

Glue and screw instructions for semi-permanent rifle set up

Strip the rifle and have parts sitting in such a way that they can be assembled with ease before any epoxy curing takes place.

Degrease the areas of the action that will make contact with the rifle stock, then apply a thin rust protective coating to the metal work. This is the type of coating used on the inside of vehicle door panels to prevent

rusting, generally oil or wax based. I recommend CRC Soft Seal which sets to form a firm barrier. Fish oil based products can also be used. This will be used as both protection and as your release agent. Make sure the rust prevention agent does not enter areas such as the bolt release or trigger mechanism as these parts need to be free moving. Use protective lubricant on these parts. The goal is to protect the metalwork of your rifle, whether stainless or chrome moly, for a period of up to one year or more; and as already mentioned, the product you choose also needs to act as a release agent. Obviously, the product you choose needs to set semi dry and firm to form a thin but strong barrier. If the release agent is applied too thick, the action may eventually develop some wriggle room with a negative effect on accuracy. A thin film is much better, the adhesive rust preventative bonding to the action, the epoxy bonding to the rust preventative coating, a tight fit finalizing the rigid mount bedding.

While the release agent is curing, you will need to apply a light coat of grease to the action screws. This will ensure that they do not lock should any epoxy leak into the action screw holes.

Once the action is prepped, lightly degrease the stock and prepare the epoxy. When the epoxy is mixed, apply it to the rear of the recoil lug. Next, apply epoxy to the bottom and sides of the stock where it will meet the action. Following this, bring the barreled action and stock together. Use cotton buds and solvent to clear the action screw holes, then insert and torque the action screws. Be sure to cleanup any seepage with your cotton buds before the epoxy cures.

Glue it and screw it. This rifle is a Remington M700 mated to an Accuracy International Accuracy Enforcer (AI AE) chassis. This is quite a common combo these days. The M700 action is similar in form to the AI AE action (not AI AW which is a square action). In the above photo, I am building up epoxy behind the lug.

In this photo I am building up epoxy in the AI AE stock; one of its mud guard panels can be seen in the background. One very important note: If your rifle has an oversized aftermarket Holland recoil lug and is fitted to an AI stock, you will need to disc the front face of the Holland lug so that it does not bind in the AI chassis recoil lug recess. Use roloc discs for this work and mask off the barrel to prevent marring. The 700/Holland/AI combo simply won't shoot well if the lug is pinched in place, ruining the fit and placing the entire system under stress.

Please note; to avoid potential action or stock stress, it can be very useful to **refrain from setting the action screws to full torque settings until the epoxy has fully cured.** While curing, use just enough torque to keep the action in place. If the barrel is heavy and requires support during curing to prevent action stress, then find a way to support the barrel during curing.

Doing the tango.

Glue and screw bedding makes for a tough, ready for action rifle, but in most cases is certainly not the best for long term maintenance. Only you can decide whether glue and screw bedding is right for you. If we take the M700 mated to the AI AE stock as an example, the removable side panels help a great deal with maintenance; and as far as accuracy is concerned, you simply won't get the best out of the rifle with metal to metal contact. Sure, the rifle may group well, but with the glue screw method it is possible to get down into the sub quarter minute region - nice!

Clearing the action screw holes in the underside of the AI chassis.

Maintenance schedules will depend on usage. If the rifle is not exposed to extremely dirty or corrosive environments you may not need to pull the job down for two years or more. If you fall into a swamp with your beloved, it is of course best to strip the rifle down upon returning home. The rifle pictured in this tutorial has not been pulled down for three years. The side panels can be removed for basic maintenance but one day the rifle will need to be pulled down for trigger cleaning and re-lubrication. Nevertheless, after each shooting session, this rifle has been cleaned with generous amounts of CRC Long Life which has also been sprayed down into the trigger unit.

Cleaning up the bead of epoxy. Note how the AI stock has no side walls. This negates the use of bedding compound to some extent, as the fill would be very minor. Proper epoxy bedding would involve a whole lot of work for very little contact area while the prep would destroy the value of this stock.

Again, we need to discuss goal accuracy. If you have used the glue and screw method for mock bedding but taken shortcuts with little care taken to epoxy most of the action in place, aim for groups of around .5 to 1” at 100 yards.

If you have carefully glued and screwed an action to an aluminum chassis as a semi-permanent bedding solution, accuracy will be optimal. If the barrel is capable of sub half inch accuracy, the glue and screw method will deliver

Summary of Key Points:

- Glue and screw can be used for either preliminary testing or as a semi-permanent bedding solution.
- Glue and screw (like mock bedding) is best described as a rigid mount bedding with no return to battery system.
- Glue and screw requires full re-application each time the rifle is disassembled for cleaning.

Tikka T3 setup for testing and final field usage

The following instructions are for the Tikka T3 factory rifle. If you have re-barreled your T3 rifle or have fitted an aftermarket stock, the rifle will need a proper bedding job.

The Tikka T3 is a fairly robust rifle but the setup is critical. These instructions can also be used to set up the Sako A7, Savage Axis and Ruger American.

After stripping down the T3 rifle and adjusting the trigger, grease the action or spray with CRC Soft Seal. Make sure the recoil lug is coated to prevent a galvanic reaction between the aluminum recoil lug and stainless action (stainless steel rifle models). You can use other products for protection if you wish - as long as you can ensure that the lug and action are fully protected with a product that will not migrate away from where it is needed. If the lug reacts with stainless, over time it will turn to powder and crumble - looking much like a very sad car battery terminal and compromising the effectiveness of the lug with a potentially negative effect on accuracy. Grease or CRC Soft Seal (and other tacky oil or wax based rust preventatives) help prevent corrosion

which can occur on both the 400 series stainless steel and chrome moly variants of the T3 rifle.

While we are on the subject of the recoil lug. Be very wary of the new aftermarket oversized T3 recoil lugs. You can opt for an aftermarket stainless steel or titanium lug but do not opt for a wedge-jam-force variant. The 10 thou slope is there for a reason: to allow the action to return to battery. Aluminum is used because it deadens vibrations, in the same way as the brass used in the Mauser military rifles.

With the action, underside of the barrel and lug greased (or barrier coated), carefully reassemble the rifle. The next step is to fit the action screws, and I suggest that the top of the threads be passed through a stick of Loctite 248. The rest of the screw should be coated in grease or similar product.

Now for the critical part of the job: Fit the screws in place and torque to 35 inch-lbs. No more, no less! It is extremely important that you try to obtain a torque wrench for this job. If you cannot afford a torque wrench, my best advice is - just firm.

Loctite is utilized to keep the screws from coming loose with such a light torque setting. I guess you could use thread tape in a pinch. If the action screws are over tightened, the plastic stock of the T3 will often compress and splay while wood stocks will also sometimes compress over time. Once this occurs, the T3 action is left riding the top of the recoil lug - an area it should not contact. If the screws are loosened thereafter, it is too late - the damage has already been done. There are two remedies for a crushed T3 which include grinding the bottom of the lug down .5 mm/20 thou or epoxy bedding which is my typical recommendation.

Generally I recommend pillar bedding both the laminate and wood stocked T3. The Plastic stocked T3 rifles can also benefit from basic

bedding or pillar bedding. But for the purposes of preliminary testing, careful assembly is enough to give us some idea of accuracy potential with groups often ranging in the region of a half minute. Ammunition and recoil are both factors that can limit accuracy when using the Tikka T3 so be sure to have your game face on. Do not use a bipod when testing the Tikka T3 rifle, as the preloading will affect forend rib pressures and also produce recoil associated problems. The Tikka T3 gives best results when shot over sandbags at the rifle range and over a pack in the field.

If your T3 or A7 rifle does not have a free floated barrel, do not attempt to free float the barrel unless adopting full epoxy bedding. The pressure point ribs of the T3 tend to help the factory rifle immensely and because they are not located at the forend tip, do not generally cause vertical stringing in a meaningful manner.

To summarize the T3 test phase, we could say:

- Tight groups - job done.
- Groups of around .75” to 1.5” - bed rifle if desired (may also be a result of loads and technique).
- Wide groups - possible bore problem (but must check technique!).

As discussed in the first book, the Sako A7 is problematic in its design, but this rifle does have the potential to show major improvements with bedding. All I can suggest is that the rifle is assembled as per the T3 instructions and test fired in the same manner. If groups are exceptionally wide, the barrel may be at fault. You may wish to try mock bedding to isolate the barrel as a variable before venturing into full epoxy bedding.

If you have adopted a custom aftermarket stock for your Tikka, it is best to epoxy bed the rifle. You may wish to try mock bedding first, but

ultimately it is important to bed aftermarket Tikka stocks to get the very best out of your customized rig. On occasion I have also found that the factory laminate stocked Tikka rifles sometimes lack the same ‘fluke of design’ fit that occurs with the plastic stocks (see first book). These can be worth mock bedding if any accuracy issues arise following initial tests. A simple area to focus on is the first section of the barrel channel.

A Tikka T3 with custom barrel and stock (this 7mm-08 project was mentioned in my first book - rifle round up section). Epoxy resin bedding is the key to optimum accuracy once the T3 is customized.

Summary of Key Points:

- Strip Tikka, adjust trigger and then apply grease to prevent galvanic reaction.
- Action screws should be set to 35 inch-lbs.
- Monitor shooting technique. Do not use a bipod when test shooting this rifle - use sand bags.
- Observe group size and decide on course of action.

Torque settings

The following are my own recommendations for action screw settings (lubricated with either grease or Loctite 248 stick):

- Plastic stock rifles with floating lug: 35 inch-lbs
- Plastic stock with floating lug, bedded: 45-55 inch-lbs (be weary of the plastic floor plate on Tikka rifles).
- Plastic stock rifle, unbedded (e.g. SPS):: 40-45 inch-lbs
- Plastic stock rifle, bedded (e.g. SPS): 55 inch-lbs
- Plastic stock with pillars (Hogue): 55-60 inch-lbs
- Glass stock rifle with unknown fill: 40-45 inch-lbs
- Glass stock rifle with ali chassis: 55-60 inch-lbs
- Wood stock rifle with floating lug: 35 inch-lbs
- Wood stock, bedded or unbedded but without pillars: 40-45 inch-lbs
- Wood stock rifle, pillar bedded: 55-60 inch-lbs
- Laminate stock rifle, bedded or unbedded but without pillars: 40-45 inch-lbs
- Laminate pillar bedded rifle: 55-60 inch-lbs
- Ali chassis/tube rifle: 55-60 inch-lbs

You may have noticed that I rated the laminate stocks to 40-45 inch-lbs. This is because on occasion a laminate stock will delaminate under heavy torque. If you want the very best out of a laminate, I suggest pillar bedding.

The following are my recommendations for bases and rings, lubricated with Loctite 248 stick:

- Base screws: 18 to 25 inch-lbs
- Ring screws: 20 to 25 inch-lbs
- Ring cross bolts: 45 inch-lbs

Step 6 - Fit optics

Finally we are ready to fit optics. Even if you are mock bedding for trial testing, I still recommend setting up your optics as you would if setting up long term.

Your rifle will need to be held securely during the optics fitting process. The assembled rifle should be set in a vice or gun vice. If you have neither, utilize a bipod. However, if you use a bipod, you must remove the bipod when checking lateral cant as any uneven weight distribution of a bipod can affect alignment, tilting the rifle to one side or another during testing.

I use brake cleaner/degreaser to clean the top of the action and underside of scope bases and tips of the base screws. Following this I very carefully apply two pot syringe type epoxy resin to the base or bases while keeping resin away from the screw holes. Spread the epoxy all about so that a good shim is obtained.

Next, I roll the tips of the base screws across the edge of my Loctite 248 stick. In the past I have used liquid thread lockers but as I have suggested elsewhere, this can migrate under pressure down into the

barrel threads. Therefore, I now use a stick and try to avoid surplus Loctite on the very front of the screw.

If using a rail, fit one screw at each end, nipped up lightly. Next, clear the remaining screw holes of epoxy use brake cleaner and a cotton bud (you may have to shred the cotton bud a touch). Following this you can insert the remaining screws. If using two piece bases, fit one base, one screw, then clean the other screw hole, then fit the second screw. Repeat the process for the second base. After the base or bases are nipped in place and you are sure that no epoxy is in the screw holes (unless you work at a tactical rifle 'chop shop' and like to see epoxy go right through the action), you can then commence tightening the screws in place. It may also pay to check that none of the screws are protruding into the rear of the action.

Preparing a scope base with epoxy resin. This base will sit atop a Tikka T3.

Following this clean up the bead of epoxy that has squelched out from the edges of the base/bases. Use brake cleaner to ensure that all residues are cleaned away, then immediately re-apply a protective coating to the action and base. I really go to town with grease at this stage, pretty much plugging the top of the base screw holes so that the heads remain corrosion free for future removal.

The next job is to fit the rings. If you are using weaver style bases or a rail, the cross bolts in the complementing rings should have the thread tips degreased and should then be given the Loctite treatment (these guys are doing well out of this book, huh). The rings and their cross bolts can then be fitted in place. When fitting each ring to the base, it is extremely important to push the base hard forward towards the muzzle of your rifle - after feeding the cross bolt through the base slot and before nipping up the cross bolt. This will ensure that the rings mate with the front of the cross slots in the base and do not move under recoil (the scope wants to move forwards under recoil, not backwards).

Many folk will now set about lapping the rings. The ‘chop shop’ will often lap rings because it sounds pretty cool on their long accurizing job list - most of which was either half done or pointless. I am not one to jump straight into lapping. I use it when there is a definite problem, such as custom Mauser jobs from whence much of the need for lapping originated. But generally, I will study the alignment of the rings first, using my vernier caliper as a straight edge and looking for daylight at the bottom and sides of the ring halves. Unfortunately, mass produced rifles can have screw holes out of alignment which can affect two piece base alignment. But rather than lapping, I prefer the simple solution - Burris Posi-Align rings.

A couple of things to consider here. I currently use Burris Posi-Align rings where possible because the plastic ball jointed inserts prevent marring and align the scope, as well as offering 10 and 20 minute

canting for long range work. If I cannot use these, I tend to use a one piece base and Leupold rings and have never found a need to lap these. Nightforce have equally good kit. But very occasionally, I will come across some weird rifle jobby that only takes proprietary brand rings without inserts; and that is when we need to look at front and rear ring alignment.

A Warne base and Burris Posi-Align rings mated to an M700 action.

There is not much point lapping windage adjustable Burris or Leupold two base and ring sets - except for the issue of height alignment. However, if height is an issue, I generally shim with brass or ali drink cans under one of the bases in conjunction with epoxy to obtain the correct alignment.

A lapping bar is very useful, but please understand that your life is not dependent on a lapping bar unless the rings are noticeably out of alignment. I should not really say this, but a good scope can handle very minor discrepancies in alignment. I have seen older guys epoxy the scope to the lower ring halves to solve alignment problems, the epoxy

used to fill gaps and as a protective shim. The epoxy is allowed to cure before the top halves are fully tightened. I can't really see any problem with this fix, provided a release agent is used on the scope body. If you think about it, this is another way of making something similar to the Posi-Align insert, albeit for the bottom ring half only.

With the bases in place, fit your ring screws loosely in preparation for testing eye relief and horizontal cant.

Eye relief is the first port of call. You want the scope as far forwards as you can manage, in order to avoid the optic giving you a kiss on the eyebrow, but you need to take hunting clothing into account too. If you hunt a lot during the winter, you may be wearing a heavy jacket. So, if you need to, wear your heavy jacket during this set up phase. It also pays to test the scope at both minimum and maximum magnification.

In days gone by we were told to set the scope in such a way that if you shift your head slightly from side to side no half moon shadow appears. Nowadays, many target shooters set their scopes forwards to the point of creating a full and heavy 360 degree shadow (vignette). The target shooter then uses this shadow to check whether he or she is properly aligned with their target. If the shadow becomes a half moon, the shooter knows that alignment is incorrect which will negatively affect the point of impact (POI).

I find that on hunting rifles the practice of deliberately setting a shadow tends to cause the shooter to crane forwards in order to gain a full sight picture and take in surroundings, even when snap shooting and also especially in low light conditions. My recommendation leans towards the old methods: to set the scope at a point where you see neither the shadow nor are so close as to be viewing the scope internals - seeing the thinnest possible optical ring. If you move your head slightly from side to side, you will still see a shadow but it will be very subtle.

Once you have the eye relief set you will need to set the vertical cross hair to a true vertical position. The old method was to set the crosshair to where it felt about right. I have handled scores of client rifles which have been set up with the vertical crosshair at about 1 o'clock (right hand shooters) because this felt about right. This set up is quite OK for normal hunting, and so long as the hunter does everything the same each time he or she shoots, the results are more than adequate. But as we get into precision work, we have to correct these finer variables if we are to succeed in the field.

I have mucked around with all sorts of levelling devices for this task, and for the most part it is all bollocks because the tools have no truly accurate point of reference to obtain vertical to begin with. So, let's cut the crap here, save a bit of money, and utilize our common sense. Our eyes can discern true vertical if we give them a chance. What catches us out is the shape of the rifle forend and/or our grip. If the forend shape or the way we grip the rifle causes us to cant slightly, our eyes tend to try and balance everything out for us - and this is where we get caught out at 11 and 1 o'clock.

My method for correcting lateral cant is simple. Set the scope to vertical as best as you can by using two positions. The first is your natural shooting position; the second is to hold the rifle forwards, pistol grip or floor plate in one hand, the other hand holding the butt stock. At this extended distance you can align the scope with the bases, action, and butt pad. That said, some rifles have a slight twist to the butt pad (normally wood stocks), so the scope base and action will be your main measure of alignment. You can only do this for about 1 minute before you need to put the rifle down, because your eyes will start to play tricks in an attempt to help you. So, when you think you have narrowed down the cant, nip up two opposing ring screws lightly, put the rifle down, and walk away for a while. After your eyes have had a good rest, come back to the job and have another go. You will simply need to keep

working at this: align, rest, align, rest - until you have got it right. As I have said, if you give your eyes the opportunity, utilizing a good procedure, they won't let you down.

Once the scope is set to true vertical, you can finally tighten the ring screws. Nip each screw up a bit at a time, working from side to side in order to avoid setting up cant during compression. It is up to you whether you utilize Loctite on the ring screw threads. In most instances these screws hold well and do not need Loctite, but you can use a small smear of Loctite if you wish. Over the past four years I have not been using Loctite on ring screws. I may go back to doing this one day, but for now all of our client's rifle optics appear to be holding firm.

If you are using Weaver rings with steel straps that have ring screws on one side only, you will need to precant these. If the ring screws are set to the right of the rifle (ejection port side on right hand rifles), the vertical crosshair needs to be set to 11 o'clock. Following this, tighten the ring screw and then assess whether the crosshair has rolled over to true vertical. If the crosshair is not vertical, you will need to undo all of the screws, re-guess the correct precant, then retighten. Weaver rings take a bit to set up but are fine once they are in place. The newer Weaver 4 screw split rings are much easier to work with it this regard.

If utilizing aluminum rings such as Weaver, do not use Loctite on the cross bolts or ring screws. Aluminum is self-binding and the mild steel screws will easily lock in place.

Regarding Loctite grades, I highly recommend the medium strength 248 grade. These days I am finding that if I use the 248 grade as opposed to more mild loctite grades, I can stay closer to 18 inch-lb settings for bases and 20 inch-lbs torque settings for rings. I have quite a few client rifles in circulation that have been set to these specifications, and all have remained secure over the last few years, allowing me to gradually gain confidence in my decision to back off torque settings a touch. By

the same token, I have on occasion had to push beyond these recommended torque settings for when dealing with such hot numbers as the .375 RUM. Nevertheless, my advice is to start out with caution. A heavy handed approach can result in stripped screw heads or frozen screws.

Before we leave the subject of fitting optics, we need to talk about the differences within torque wrenches. Just because a Torque wrench has X torque setting stated, it does not mean that this is a true indication of the actual torque setting. I would suggest that you expect an error range of about 3 inch-lbs. A very cheap tool may have an error of perhaps 5 inch-lbs. I use a Wheeler FAT wrench. Wheeler is a U.S company, but the products I have bought from them so far have all been made in China. Fortunately the wrench came with a test certificate that showed the actual calibrated torque setting of my particular wrench. With this certificate I know that if I set the wrench to 20 inch-lbs, it is actually yielding 22 inch-lbs. Wheeler isn't trying to hide anything with this wrench, making sure that the end users have all the information they need. And therefore I can highly recommend this tool to all rifle owners.

One last thing we need to cover is longitudinal scope cant. Many of you will be setting up long range rifles and will want to employ a good measure of longitudinal cant. This basically means that the scope is set up in such a way that after you zero the rifle, it will be towards the bottom of its elevation windings. In essence, the scope is pointing slightly downhill towards the muzzle. At the same time the muzzle will be pointing slightly uphill, forcing you to dial down to the bottom of your turret elevation in order to be able to sight in at 100 yards. With the elevation turret now at a low setting, this allows us to dial up the elevation turret several windings for long range shooting. As suggested, Burris canted rings are a great way to obtain longitudinal cant. A thick insert can be placed in the bottom rear scope ring, a thinner insert

placed in the bottom front ring (towards the muzzle), thereby tilting the barrel upwards relative to the line of sight. Sometimes however, even this is not enough cant. Much will depend on the final polishing of the action during manufacture: perhaps there was a heavy casting mark, and after polishing the height of the front and rear of the receiver (where the scope bases sit) was finished out of whack. A one piece 20 MOA canted base (picatinny rail) is the way to go here. But what if you cannot obtain a canted rail?

If you cannot obtain ideal cant you may have to use shims. These can be employed on rifles which accept Weaver style bases as well as Leupold bases. Common sense dictates that shimming cannot be utilized on Ruger or Sako rifles which utilize integral ring mounts.

With a bit of forethought shims can be made as strong as any mount system. Brass shim (engineer's supplies) is ideal; aluminum drink cans (surface roughed up with sand paper) can also be used.

The first step is to make your shims: Use scissors to cut them to shape and drill the screw holes with a slightly oversized drill bit or hole punch. You can use two or three of these, stacked one on top of the other under the rear scope base (or front if the scope needs to come up). At this stage you are only fitting the shims to the rifle temporarily. Next, perform a quick bore sight to see if you are where you need to be and if you need to add or remove shims.

Once you are set to go the key factor is to laminate the shims using our double syringe epoxy resin. Apply the resin under, in between, and over the shims. Once this is set in place, it will make a very solid mount. The laminated resin will also add a few minutes cant. There is no need to worry about the base lacking strength, as you will see for yourself if you have to employ this method.

Again, I would recommend using Burris rings with plastic inserts if shimming two piece bases. Failing this, it is important to lap the rings, if you choose to shim and cant two piece bases.

Shimming can be employed if you have fitted a 20 MOA canted rail but have then found that your scope simply cannot be adjusted down far enough to allow you to obtain a 100 yard zero (or 3” high at 100 yards as I generally prefer). The trick is to shim the front of your receiver in order to lift the rail a fraction which will then set the barrel pointing down relative to the line of sight.

Summary of Key Points:

- Fit bases with epoxy resin as vibration dampener.
- No epoxy in screw holes.
- Use stick loctite rather than liquid on base screws if possible.
- Check ring alignment or use self-aligning rings.
- Check lateral cant of scope.
- Take longitudinal cant into consideration.
- Set optimum eye relief.
- Tighten screws to recommended torque settings.

Step 7 - Test rifle, break in barrel

Now comes the moment of highest anxiety. There may be shouts of triumph - or the relaying of sad stories of defeat to wives and friends. The bore really has the final say.

We will not be covering hand loading or shooting technique in this book, but I want to make a few things clear before we move ahead.

To begin with, all we are interested in at this point is establishing some basic information. You may be lucky and strike it right first time, but your mindset needs to be geared towards preliminary testing - not instant long range death star!

Shooting tests should be performed over sandbags if at all possible. Bipods can be tested and utilized later as a final phase when sighting in for hunting.

Please keep your hand loads basic. Every now and then I come across some wit who decides to experiment with three different powders and three different bullets at this stage, adding multiple unmeasurable variables into the mix. This is just so fundamentally wrong. Pick one bullet that is matched to the twist rate of your rifle, preferably something soft that swages easily to the bore for preliminary testing. Bullets like the Hornady SST are wonderful to use for hunting, but in some rifles the thick jacketed SST can be finicky. So, if you want to shoot the SST, go for it. But in this case do not blame the rifle immediately, if accuracy is poor. Instead, test different seating depths or adopt a second softer bullet for preliminary testing; a bullet such as the basic Interlock. It is my hope to cover handloading in detail in a future member of our book series.

Go to your reloading manual, look at the suggested loads, and work up your loads in half grain increments - three shot groups. I suggest twelve cartridges of the same charge (start load) for the initial break in. Do not pursue fancy ladder tests with fancy acronyms! You may not have the experience to guarantee that every shot is on the money - devoid of human error. Set your seating depth for optimum concentricity versus optimum bullet jump (explained in my second book - Long Range Cartridges).

In some instances a rifle may display best accuracy at full pressures. If you are using a reloading manual, there will be times when the listed maximum loads do not allow you to reach full pressures, if the chamber or bore of your rifle is of more generous dimensions than powder manufacturer's test barrels. That said, I cannot condone the practice of loading above the maximum charges listed in reloading manuals. Nevertheless, I have supplied typical powder charges and sweet spots for many cartridges in my second book along with relevant safety warnings. This load data can be useful for developing full pressure loads. Along with this and as I have mentioned, I hope to deal with load development as a part of the reloading process in a future publication.

If you are unsure of your hand loading abilities, I suggest you use Federal ammunition for preliminary testing as this ammunition is generally of reasonable accuracy. Again, match the bullet weight to the twist rate of your rifle in order to avoid bullet stability problems. Along with Federal ammunition as a base, you will need to adopt a couple of competing brands of factory ammunition to widen your test range. Winchester and Hornady can be very useful. Hornady Interlock soft point ammunition versus Hornady SST Superformance ammunition is another route. If you are unsure of twist rate, then adopt two separate bullet weights. Bear in mind that during preliminary testing we are not too concerned with tack driving accuracy. All we want to see are nice triangular groups of a reasonable size which will allow us to draw a picture of performance.

Once you have decided on your ammunition, it is time to break the barrel in. At this point we need to have a full understanding of the bore.

For the past year I have been working with Grant Lovelock at True-Flite NZ Ltd (New Zealand rifle barrel makers) to ascertain what really counts when it comes to making an accurate rifle barrel. When Grant purchased True-Flite many years ago, the business was already well

established with a good reputation. But after a time of continuing operations, Grant found that on occasion a barrel would turn out less than optimal, as seems to be the case in all barrel manufacturing operations. In such cases Grant would replace the barrel if it was found to be at fault. But even with this good will, it was a frustrating process for both customer (time and ammo) and True-Flite (labor, materials). However, this was not the worst aspect of it all. Once NZ hunters began to use internet forums, it only took one unhappy customer to sow the seeds of doubt.

A second potential problem for Grant was copper fouling. While hunters are content with a gradual buildup of copper fouling, competitive shooters (and military) require a low fouling bore that will shoot all day. Grant was building an international profile amongst target shooters, so the issue of copper fouling also needed to be addressed, if he was to gain a competitive advantage. As a result Grant set about experimenting to further improve his barrels.

For a time he experimented with various High tech lubricants to improve both finish and form. The next step was to experiment with hand lapping beyond True-Flite's existing procedures. I tested the barrels at the range and was also able to take these experiments to the extreme. The summer of 2012/2013 saw me shooting an average of 300 rounds of ammunition per week. Much of this shooting was with magnum rifles where small errors in barrel making can become major problems.

The following is a list of the important factors, discovered during my own years of testing and combined with the results gained from True-Flite's experiments:

- If the bore or chamber is rough, copper from the bullet vaporizes and is deposited throughout the bore as a heavy coating. This will cause poor accuracy of subsequent shots,

due to the fouling inhibiting bullet grip. (NB- these tests were carried out with factory rifles, not True-Flite barrels!)

- If the bore finish is too high, the bullet can repeatedly slip and grab, which in turn will lead to dangerous pressures and “buck shot” accuracy.
- If the finish is too high, accuracy is extremely poor when using a heavy bullet in a slow twist barrel. In this case a rougher bore would give at least acceptable accuracy (e.g. a 200 grain bullet in a 1:12” twist .308 for bush hunting). By the same token, if the finish is very high, a fast twist magnum may not stabilize bullets. A typical example of this is the 1:8 twist 7mm bore commonly employed by magnum shooters. This twist rate is already border line for the 7mm magnums. A high finish can cause further problems, even if the bore is dimensionally sound - to the point that in extreme cases, some bullet designs will tumble at moderate to extended ranges.
- If the finish is too high, the bullet can fish tail after exiting the bore and lose ballistic coefficient.
- Good accuracy is achieved when the bore dimensions are at least even from chamber to muzzle. But accuracy seems to be enhanced if the groove diameter is biased slightly smaller toward the muzzle (as is accepted in Small Bore Rimfire barrels).
- If the bore is dimensionally sound, good accuracy can be maintained if the bore finish is high and the rifle produces minimal or seemingly zero copper fouling - providing twist rate is matched to bullet weights and velocities.
- If bore dimensions are unsound, it is important to have a good measure of copper fouling (but not immensely heavy). Therefore, a highly finished bore of unsound dimensions is the worst case scenario.

- If twist rates are unsound, copper fouling can aid bullet stability.

Before experimentation Grant had a good handle on what made a good bore, dimensions being one of the key factors. But up until these experiments, a lot of this information was handed down theory. It was only through hands on experimentation that we could see what affected what and how much each variable really mattered. There is a difference between knowing something and fully understanding a thing inside and out. Following these experiments, Grant was able to build a lapping machine that optimized both bore dimensions and finish. Neither was fully exclusive of the other - such were the subtleties discovered. The current True-Flite Ultra match barrels have produced incredible accuracy with, for example, all test groups during a load session ranging from sub quarter minute to sub minute regardless of powder charge. The varying powder test charge weights also produced low velocity spreads (ES) across the board.

So, what can we learn from this ourselves? Bore dimensions are of great importance. Bore finish (and the chamber throat surface finish) is important, in that we need to avoid heavy, gloopy plasma copper fouling. Zero fouling is OK, if we have a muzzle tight or even dimensioned bore. But if the bore is muzzle loose or uneven, we need a measure of copper fouling. Now, you probably don't have a pile of test equipment to study bore dimensions by yourself, but you can start making basic observations. You can also avoid unfounded absolutes like: "The bore has to produce very low fouling to be a shooter".

The most important point to remember when it comes to breaking in and caring for rifle barrels is: each barrel has to be treated on an individual basis! I have often read about procedures for breaking in rifle barrels that are so inflexible as to be total rubbish.

Understand this, there is no one rule for all rifle barrels because as an end user you have no control over manufacturing processes.

From my own studies over the years, including the recent intensive studies with True-Flite, my conclusions are that the bore needs to be of a finish comparable to that of food grade vessels - ranging from 180 grit, through to around 320 grit as an upper limit. As we go higher in finish, bore tolerances become critical.

As mentioned, twist rate can be a critical factor. These days we have all sorts of experts telling us that fast twists are the business for long range bullet stability, but few take bore dimensions, bore finish or velocities into consideration. These three variables can have a pronounced effect on accuracy and make a dream custom rifle shoot like a shotgun. A simple preventative measure is to avoid aggressive twist rates (custom barrels) when adopting magnum chamberings or any cartridge that is capable of launching bullets faster than 3000fps. Not too long ago I studied a Kreiger match barrel that produced tumbling, the bullets key holing at 100 yards. After intensive studies of the bore, again with the help of True-Flite, we found that the bore was dimensionally sound while the chamber was in optimum form. The problem was simply too much velocity in conjunction with an aggressive twist rate along with a high finish. Bullets tumbled when the bore was clean and only obtained a degree of stability once a measure of copper fouling was obtained. Had the rifle been chambered in 7mm-08 Remington or .284 Winchester at the upper end of the scale, the barrel would have shown greater promise. To reiterate, the problem was not the barrel - but the choice of twist rate versus intended velocities.

We have little control over the temper of a barrel. If we are determined to work with a barrel of poor temper (generally stringing wide or wide double grouping), we have only a few choices: These include pressure point bedding or fitting a de-resonator, whether purchased or machined

after our own creative designs. A de-resonator is best described as either a counter weight or a rubber shock absorber that can be clamped to the barrel at a mid-point (experimentation) in order to dampen vibrations. Many of you will simply want to bin a barrel of poor temper and start over - I tend to do the same.

With that clarified, we can proceed.

Summary of Key Points:

- It is important to understand the relationship of bore finish, bore dimensions and twist rate with regard to precision rifle accuracy (refer to previous bullet point list).
- All rifle barrels should be treated on an individual basis. There is no 'one method' for barrel break in procedures.
- If handloading, a soft bullet can sometimes swage more easily to the bore.
- Use basic sound handloading techniques and incremental load development.
- If using factory ammunition, start with Federal brand but also incorporate a range of other brands.
- Choose a bullet weight suited to your barrel twist rate.
- Test rifle over sand bags.

Tools for breaking in a rifle barrel

Please note, if you have a chrome lined bore (e.g. AR-15), you will need to read the chapter titled Chromed lined bores in part two of this book. If you do not know whether the bore of your rifle is chrome lined, you will need to seek this information from the manufacturer.

When I go to the range to break in a rifle barrel (can be a long tedious day), I take my cleaning rod, bronze brushes, copper solvent, degreaser, CRC Long Life (CRC SP-350), 4x2 patches, maroon Scotchbrite (or Norton Bear Tex pad), White Bear Tex pads, and finally Autosol. I also take grey Norton pads but this is not 100% necessary. Other kit includes a transistor radio, hearing protection, a decent hat, water, and so it goes on. With this kit I am set for the day. I have also listed all of my kit at the beginning of this book for full reference. At this point I would like to spend a bit of time going over some of the tools we might or will be using for breaking in a rifle barrel.

Both 3M (eg Scotchbrite) and Norton make abrasives for the engineering sector, and while you may be familiar with Scotchbrite pads for cleaning pots after it was your turn to cook dinner, these poly pads have been used in the engineering sector long before you started burning cookware.

Both Norton and 3M use the same color coding to denote grit size (like sand paper). These include:

- Brown - Approximately 120 grit.
- Green - Approximately 180 grit.
- Maroon - Approximately 240 grit
- Grey - Approximately 600 grit.
- White - Non-abrasive (cleaning).

These grit sizings do not however directly correlate to sanding sheets, as poly pads tend to soften very quickly. The Brown grade for example

tends to behave more like 180 grit, Green leaves a 240 grit finish, especially when used at high speeds with grease (rendered fat). Maroon tends to start at 240 grit and soften to around 320 grit. At high speeds, wheels or pads featuring these polymer abrasives can be used to finish food grade stainless steel vessels by closing the pores of the steel after removing welds, in order to prevent food deposits and therefore pathogens adhering to the steel.

As rifle owners we can utilize poly pads to both cut and polish barrel steel. We also need to exercise caution, so it is best to treat poly pads as per the grit sizes given above. The poly pads need to be cut down to a width of around 1 inch with the length being the same as your jag. You will then need to delaminate each pad. In other words, peel the pad in half.

I use a rubber coated cleaning rod but these are somewhat hard to come by these days. I suggest either a plastic coated steel rod or a graphite rod. I am dead against stainless rods, as I do not always use a bore guide during the barrel break in process. A bore guide is great for keeping solvents out of your rifle action and also to help align your cleaning rod to the bore. But if using poly pads, the pad can be very difficult to pass through the bore guide. So, while a bore guide can be very useful I also prefer to see shooters use a coated rod or graphite rod for flexibility of operations.

I use bronze bristle brushes to remove stubborn copper fouling in conjunction with copper solvent. As the bronze brush wears down (also eaten by copper solvent) and becomes too small for the bore, it can then be used as a jag for either 4x2 cloth or poly pads. You can also deliberately use undersized bronze brushes as jags for poly pads, using a 6 mm jag on a 7 mm bore as an example.

4x2 cloth, Autosol polish, Tipton bronze brushes and poly pads.

For many years I used Sweets 7.62 ammonia copper solvent to remove copper fouling, but over the past few years I have not been able to obtain this product in New Zealand. So, of late I have been using Bore Tech Eliminator, often in conjunction with Bore Tech Chameleon gel. These have produced excellent results. That said, KG 12 has also proven to be an exceptional product. The most important thing to remember here is that your solvent needs to have some welly - some real get up and go. I have lost count of the times that folk have contacted me, saying that they have been using Hoppe’s No.9 as a sole copper solvent, but that they have “just discovered” that the solvent is not working. They have noticed that the rifle has lost accuracy and eventually worked out that copper buildup is the problem. Hoppe’s is a great product. Hell, I used it as cologne when I was a boy (I had no idea how toxic the original recipe was). Hoppe’s is not however an aggressive copper

remover but is ideal for low copper fouling rifles and great for breaking down carbon. KG 1 Carbon Remover is another excellent product and is particularly useful for braked and suppressed rifles as a means to remove heavy carbon caking.

There are many rifle solvents on the market, and unfortunately many are utterly hopeless when it comes to rifle cleaning. Truly, utterly useless, pointless liquids. You would be better off taking a leak down the bore. The solvents I have mentioned here are very useful. I have also used Tetra Gun with a degree of success. A simple test for solvents is to coat a projectile with the solvent and observe how or whether it etches the bullet. All copper solvents are designed to produce a chemical reaction in order to break down copper. Generally speaking, this chemical reaction can be observed via the blue color that appears during the chemical reaction. A good copper solvent will therefore produce a measure of blue coloring if the projectile is placed on a rag or paper towel and soaked in solvent. The exception is KG 12 which leaves a brass colored residue due to its unique chemical reaction.

I use the 4x2 type flannelette patch because I can cut or rip a patch to size. Besides, 4x2 has been with us as long as I can remember. I don't think I have ever seen an SMLE pull through without the familiar pink stripe of a 4x2 rag at its tail. I go through a lot of solvent and patches with client rifles, so a good bulk product like this is very useful.

I use Autosol as a fine paste polish. JB's is another good product. Autosol is roughly 1200 grit, then breaks down to 2000 grit when hand polishing. We will not be going for a 1200 or 2000 grit finish and will instead use paste to polish the existing finish. The best way to explain this is by imagining sanding steel to a 120 grit finish. Those of you who have used a disc grinder will know that this is a very coarse finish that you can feel with your fingernails. If we put Autosol over this and buff it (we would probably have to use a buffing wheel for a full effect), it is

possible to polish the steel to the point where it is very shiny but the disc marks remain. In this instance, we have closed pores at the outermost layer of the steel but left the rough 120 grit finish underneath. Well, I hope that makes sense anyway!

In essence, we can use Autosol or JB's to keep the pores of the steel closed without affecting a mirror finish. From certain angles a match quality bore may appear as though it is mirror finished, but the same can be said of a shiny dairy tanker truck, the brush finish of the truck being around 320 grit. As another example, a satin finished stainless steel sink bench or kitchen appliance is around 240 grit. You can maintain this finish with green or maroon poly pads. You are not going to turn a satin bench into a mirror with a rag and Autosol, though you will smooth the surface a good deal.

I also use CRC Long Life as a bore lubricant which I shoot over. Long Life is very fine, however its viscosity is heavier than regular CRC or WD 40 which are very thin and do not offer great barrier protection or lubrication. In my own tests I have set CRC Long Life on fire. After it had finally extinguished itself residue remained on the steel test surface, still offering exceptional lubrication.

Ok, so that is a general look at some of the products I use. I will introduce more products as we go along.

Preparation for test shooting

We now have to utilize careful observation. If the bore is very rough, I will lap it before going to the rifle range. We will discuss this in detail in a moment.

If the bore is smooth, I degrease the bore using brake cleaner on a 4x2 patch. This helps remove factory oils and cutting fluid residues. Following this I apply a light coat of CRC Long Life to the bore. I spray the Long Life onto a fresh 4x2 patch, then spiral the patch in my fingers

(fingers need to be clean and salt free) to gain a feel for how wet the patch is. I want the patch just lightly dampened without surplus lubricant, as I do not want to bulge the bore during test shooting. The lubricating qualities of Long Life will help when smoothing any unseen burrs during the break in process while hopefully minimizing fouling. This process of lubing the bore for both break in work and/or field work is sometimes called bore conditioning. The rifle is now ready for test shooting.

Hand lapping

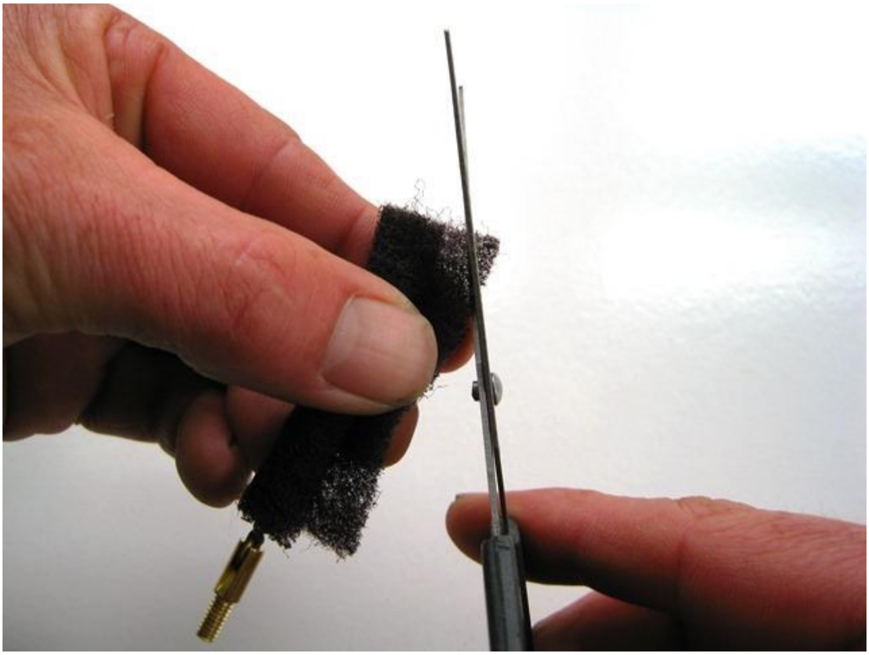
We can use lapping for:

- Removing burrs from a new bore (improve finish).
- Ongoing throat and bore maintenance.
- Improving internal bore dimensions.

To lap a rough bore, take a worn or undersized bronze bristle brush and attach a section of delaminated maroon poly pad. If you find that you struggle to keep the poly pad in place, wind a length of cotton thread around the length of the pad to keep it from unravelling. You will need to test fit the pad in the bore, it should feel quite tight but not so tight that you have a major battle to push it forwards.

Delaminating a section of maroon poly pad.

With the poly pad in place, start by first lapping the throat section of the bore (tight part of the chamber). Lap back and forwards spanning a distance of about 3 inches, giving the throat roughly a dozen strokes (24 counting back and forwards). At this point, you are removing circumferential reamer marks from when the barrel was chambered. This will help to clear gun drill burrs from the throat and also the first section of the bore.



Fitting the poly pad to a bronze brush. You may also wish to cut the lead corner of the pad off (shown above) to make insertion easier.

Next, work on the length of the bore, stopping about 3 inches short of the muzzle. We are not going to be dainty about this, as you might read in some gun magazine article written by M.Y. Armchair. I want you to get in there and give that barrel a good kick in the pants. Some folk really get their knickers in a twist about how to pass a jag through a bore, as though it were made of soft wax. If you want to play dolls and tea sets, this is not the book for you - we are all about business here (says the man who played dolls and tea sets with his daughter only last week)!

Cotton thread can be used to help keep the pad in place. Try not to get too heavy handed with the cotton. Also, there is no need to tie knots to keep the cotton in place - you will find the cotton binds easily.

Again, give the length a dozen strokes. The pad is now becoming worn, so it is losing its cutting power. As the pad loses its cutting power, it helps ensure that the muzzle end of the barrel stays tight, with the majority of cutting occurring at the chamber end of the barrel.

After working over the midsection work the muzzle end of the bore, allowing the pad to exit the muzzle around a half inch, so that it passes back into the bore without risking damage to the muzzle. When working this area over, you will need to be very careful. About 8 to 10 strokes is the go - well controlled.

As a last effort you can work the pad through the full length of the bore from the chamber to a half inch protruding from the muzzle, about 6 strokes in total.

The next step is to employ the Autosol. You can run this out onto your bench in the same manner as loading a toothbrush with toothpaste. Next, roll the worn pad through the paste, then back into the bore we go. Work the throat over for 6 strokes, then work the rest of the bore for another 6 strokes. After this, move to Autosol on a tight 4x2 flannelette patch. Yet again, we need to work the throat over, work the midsection, work the muzzle, then finish by working the length. Repeat this with a clean patch without Autosol, as we are now working towards cleaning the bore.

When using Autosol or JB's, the paste will turn black the moment it is worked. For some folk it seems a great challenge to remove the black from the bore. I use cheap brake cleaner on a 4x2 patch, meths is also very good. You can also simply continue to run patches through the bore, but try not to get tied up in the whole spotless rag thing. If a very small amount of black remains in the bore and is showing on your rag (just a hint), leave it be - it is of no concern. Especially if you have a rough bore, polishing residue is the least of your concerns.

Finally, inspect the bore at the muzzle and check any machining/gun drill burrs. In most instances, the burrs will still be evident but they will have been smoothed out. If it makes you feel any better, you can now rename them driving bands because that sounds pretty cool.

In some instances, your polishing may fully remove the tooling marks but as suggested, this is rare. I saw this during 2013 on a Howa bore: the gun drill circumferential burrs were light enough, so that poly pad and Autosol polishing was able to remove all but a handful of very light circ marks - an excellent result. I have also used lapping pastes on rough bores in the past, applied to a tight fitting 4x2 patch. If using a lapping

paste, do not go over 240 grit and try to limit your work to the first portion of the barrel. I will not go into lead lapping here, as I believe this is more within the realms of dedicated gunsmithing.

The final step is to apply a light coat of CRC Long Life to the bore for the break in process. As suggested earlier, spray this onto your 4x2 patch and rotate it between your fingers to check saturation. The patch should feel only slightly damp, and the residue on your fingers should be very light.

Summary of Key Points:

- If the bore is rough, use hand lapping to improve finish and bore dimensions.
- Utilize lapping for ongoing throat maintenance.
- When lapping, focus on the beginning of the barrel with less work towards the muzzle as a means of optimizing bore dimensions.
- Not all burrs can be removed but they can be smoothed.
- Don't pussyfoot around, get stuck in.
- Raspberry drop tea works a treat at kid's dolls parties.

Test fire

We can now commence test shooting, having prepared either the rough bore via a preliminary lapping session or the smooth bore via basic cleaning.

Although many folk do not utilize safety glasses when shooting, it is wise to adopt safety glasses, especially when testing unfamiliar rifles. Also, the more experience we have, the more we need to be careful regarding over familiarity. As a cautionary tale, a colleague of mine had been working very long hours testing rifles when he got his ammunition mixed up while at the shooting bench. He was testing a 7mm-08 custom rifle along with a Tikka 7mm WSM. Due to his tired condition, he accidentally chambered a 7mm-08 cartridge in the WSM. When the rifle was fired, the bullet exited the bore at a moderate velocity - after all, the 7mm-08 uses much less powder than the fat cased WSM. However; being much smaller in diameter, the 7mm-08 case failed to obturate (seal) to the chamber. This allowed gas to vent back, causing the plastic bolt shroud to explode. Fortunately my colleague wears prescription glasses so no harm was done beyond superficial facial wounds. Obviously, mistakes such as this can be avoided by keeping our ammunition isolated - one rifle on the bench, one lot of ammunition. Nevertheless, safety glasses were the savior on this day. While this incident may sound like a rookie mistake, anyone who has labored over projects and gained expertise in their field will understand what I mean when using the term over familiarity. The fact is beginners often show far greater caution than experts. To this end, preventative measures such as safety glasses can help prevent potential disasters.

During this test fire, you will also be sighting your rifle in. We are not greatly concerned with accuracy just yet. All we are doing now is gradually breaking in the bore, as we walk shots across the target towards the bull. I start by sitting the rifle on sandbags, then looking through the bore at the bull, then adjusting the scope to suit. Once I am near enough on the eyeometer scale, it’s time to crank the first round down the tube.

With the first round fired (hopefully on paper), remove the bolt and inspect the muzzle. If there is zero copper fouling, proceed to adjust

your scope and fire the second shot. There is no point doing the one shot then clean, two shots then clean, etc.., if there is no bloody fouling to remove!

If copper fouling is evident, you will need to remove this copper, so that the next bullet fired continues to work the bore rather than ride over existing fouling. You can use either a bronze brush or a white non-abrasive poly pad on a worn bronze brush. Work the solvent through the bore. If you are using a fresh bronze brush, you will need to go one way only, removing the brush after it exits the muzzle with each pass. I tend to use the poly pads for reasons of time (client rifles), as I can work the pad backwards and forwards quickly.

This next piece of information is important and perhaps can really only be understood with experience. Nevertheless, I will do my best to beat this information into you. When removing copper, observe how it comes away. Of course you will need a good solvent to act as a benchmark for this discussion, so perhaps we can use Bore Tech Eliminator as the benchmark.

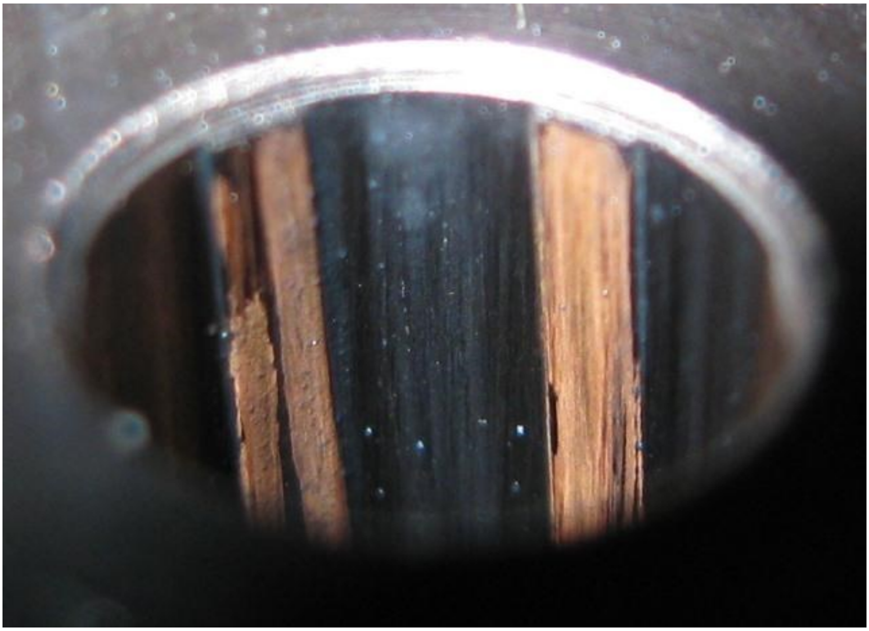
If the copper is very light and comes away easily, the bore is nearly broken in, and it is important to avoid harsh abrasive polishing. Simply remove the copper, neutralize with brake cleaner (or meths), dry patch the bore, and then swab with CRC Long Life. Following this, fire two shots and then repeat the cleaning process. Finally, fire three shots, and after the next cleaning session, the rifle will in all likelihood be broken in.

If the bore is heavily fouled and the copper proves stubborn to remove, it will need polishing. If the muzzle was chatter free there may be chamber burrs causing this heavy fouling. You will need to remove all of the copper before beginning abrasive polishing. Otherwise some areas of the bore will be polished while other areas of the bore will be protected by a copper coating. It is therefore important to use the

bronze brush or white pad to first remove copper, then focus on poly pad lapping as described in the lapping section.

We also have to test groups, which is why I have suggested twelve rounds only for the break in. If we have a stubborn fouler and we keep on polishing, we may go too far. So after twelve shots, you will have no choice but to start preliminary group testing.

My 7mm Practical bore tends to foul quite heavily and the copper is somewhat stubborn. If I had continued to polish hell out of the bore, I might have opened up bore dimensions to the point of lost accuracy. I have made peace with this rifle. It gives me about 30 to 40 extremely accurate shots. That’s enough for me, as this is a long range hunting rifle, not a competition rig. Furthermore, I prefer the rifle this way.



Heavy and stubborn copper fouling on the lands of a rifle bore after three shots, ruining accuracy.

If the bore is coated with copper to the point that some of the bullet jacket has vaporized, the copper fouling will appear as a plasma layer that seems near impossible to remove. A rifle like this can take up to four hours to clean, which is no good if you are on the clock like me. If I have to, I will start cutting into such a bore with solvent and maroon poly pad. Once I am done I will have to start over with a fresh dry pad and work through the lapping phase until the bore is once again ready and prepped with CRC Long Life. We may yet have to fire lap this bore.

And so we continue shooting, monitoring the bore. We can increase group count as we go: two shots and clean (lap if necessary), three shots and clean (lap if necessary). You must use your common sense at this point. You will often hear folk say that is takes about eighty rounds to fully break in a bore. Well, a shiny Tikka T3 bore can be broken in

within 6 rounds. By the same token, a bore with rough throat reamer marks may take a full 80 rounds. Our basic twelve round break in will of course prevent you from continuing to lap the bore from 7x57 to 8x57. I will normally have around 21 to 24 test loads, plus one fouler to fire after the initial break in. Generally I do not clean the bore between groups, as I want to observe total performance. That said, if the bore is producing extremely gloopy fouling, I may be forced to stop midway through my testing. I will then clean and re-lap the barrel. If I have a spare copper fouling round, I will fire this before continuing tests. If I do not have a spare fouler, my next three shot group will consist of one sacrificial fouler and resulting two shot group.

Grant’s current machine lapped bores are good to go from round one. I have done the polite thing and given them a clean after one shot, then two shots and three shots. But there has really been no need for this, and on the last rifle (my own) I did not bother with any break in procedure. In a smooth, lapped bore (lapped after chamber reaming) the bullet has no burrs to deal with, and there is no more lapping to be done. All we can do with this barrel (and the shiny Tikka example) is give the bore a clean and remove the light fouling as it builds up, then focus on long term maintenance.

If the bore is extremely shiny or of loose dimensions and produces zero fouling, we must hope that the bore dimensions are ideal. On very shiny bores, there is no need to shoot over CRC Long Life or similar shoot-over lubes. The last thing we want to do is to make the bore even smoother. That said, you can coat the throat section of the bore with Long Life as a means to decrease wear. I do this myself.

If the bore dimensions are no good, we will have to consider firelapping at high pressure (covered in fire lapping section). Abrasion of the start of the bore with Poly pads as a means to open up dimensions tends to be too slow, if the dimensions are well off base.

Unfortunately, a smooth bore of poor dimensions cannot be roughed up with poly pads as the finish soon dulls off - the depth of the cut is just insufficient.

Every now and then I come across a fancy rifle with a four piece walnut stock, one thousand piece action and five piece barrel which “doesn’t copper foul like the cheaper guns”. Just remember that if there is no copper fouling, internal dimensions have to be perfect. And you can bet your behind that not all rifles have perfect bore dimensions. A good bore can produce a measure of copper fouling, and this fouling in turn can be used to aid bullet stability, right up to the point the bullet leaves the bore. The drag created by copper fouling helps to maintain BC at extended ranges. I have seen this first hand, studied it in depth.

As previously discussed, target shooters need a low fouling bore in order to maintain accuracy and the same POI during a full day of shooting. Hopefully it is now becoming obvious to you that the bore must be dimensionally exceptional for this to happen. The slightest discrepancy may cause either poor accuracy either directly or more indirectly at long ranges as the bullet loses stability due to fish tailing. I think the target shooter really has a bum deal in this regard. If his bore is a fouler, he will have to manage this as best he can while continuing to work on lapping or consider high pressure lapping. The irony is, many target shooters treat the bore like a mystical portal to another world and dare not touch the bore with abrasives.

I recently received mail from one target shooter who waited till he thought his bore was fully worn out before trying my lapping methods. The result was that the rifle went back to sub half minute accuracy. He will get another two or three hundred rounds out of the bore. But had he taken the plunge and tried these methods earlier, he may have enjoyed preventative benefits rather than a last hoorah by polishing over existing erosion. Nevertheless, for those of you who are timid the

time to try these methods is after you waited till the end of barrel life (loss of accuracy). I sometimes pile it on guys who treat the bore like a princess. But I should not be so harsh, as it has been ingrained into all of us by various authorities that the bore is made of paper mache. It can be very hard to get past this, so I do understand. Now harden up!

Summary of Key Points:

- Utilize twelve shots for preliminary break in while sighting in.
- Observe rate of copper fouling and ease of removal.
- Remove copper before any lapping.
- Some bores can be broken in within a few shots and no lapping.
- Some bores require multiple lapping sessions.
- Twelve shots can help ensure lapping sessions are not taken too far during the preliminary test phase, forcing you to commence group testing.

Custom rifle set up

If you are test shooting a custom rifle you will need to have a clear idea of the role of the rifle builder versus your responsibilities. This is something that you can negotiate before the build. For example, you may have asked the rifle builder to perform accuracy testing. On the other hand, the role of the smith may simply have been to fit a barrel.

In my first book I wrote about inspecting rifle bedding, if this work has been performed by another operator. This is very important because there are now a lot of what I call ‘chop shops’, spread pretty much

worldwide. But along with bedding, it is equally important that you check the whole rifle over, including scope bases and rings. You may find this hard to believe, but some 'chop shops' are really bad. So bad in fact that this example will leave you speechless: Because they did not have any base screws on hand the scope bases were glued to the rifle, only to have the (expensive) scope fly off the rifle after the first shot. These are the kind of emails I receive from readers, so be warned.

If you have sought out a highly reputable smith, I still suggest going over the rifle. Your smith may be so popular that he has had to employ apprentices whose job it was to perform final assembly after machining. These young men may be fresh to the job and, as hard as they try, may be prone to basic mistakes, whether as a result of performance anxiety or youthful overconfidence. In this case, you have all the makings for an excellent rifle thanks to the smith's machining, but you still need to perform final checks.

A basic checklist might include:

- Disassemble rifle and check bedding (pinch points etc.).
- Apply protective coating to hidden metal (grease/CRC Soft Seal) and tighten action screws to optimal torque settings.
- Remove scope and bases, reassemble as per instructions within this book.
- Test shoot/break in barrel.

Much of how you set up the custom rifle depends on what was negotiated before the build and your ability to communicate your needs. For example, you may stipulate that the scope bases are epoxied in place and the screws fitted with loctite. If you make your requests politely in list form, both the smith and apprentice can follow the job through to its conclusion.

When I build a custom rifle for a client, it is field ready, the barrel is broken in, loads worked up, everything is done. I have to do this because, besides wanting a happy client, the job normally culminates in a field trip; and being that we live in an area where the weather is unpredictable and the terrain is harsh, the rifles need to be up to the challenge. I cannot get away with a 'chop shop' job because the client will be shooting the rifle in front of me. In other situations the whole job can go South, if the smith is of the type to immediately blame poor accuracy on the client. The client sends the rifle back to the smith; he shoots a fantastic group, but doesn't tell you he shot it at 25 yards. You have to use your good judgment in such situations. If the smith gives you a bad vibe, trust your instincts! I know this can be hard because some of the most grumpy workmen can also be incredibly gifted.

I find that newer shooters are the ones to get caught out with custom builds. The shooter has perhaps owned one or a few average rifles but nothing of great accuracy and has never really known much about what makes a rifle accurate. He then decides to set about getting his first accurate rifle and seeks a custom rifle builder. He finds himself a 'chop shop', all the bells and whistles, fancy brand names and big talk. It all goes downhill from there, complete with the final spray pack job.

If we are to learn anything from this, it is that although you are seeking the help of a professional the final outcome is your responsibility, based on decisions made during the planning phase. It is important that you have a clear understanding of what services the smith will provide. If accuracy is poor, you need to have a plan as to how you will address this. Is this going to be the smith's responsibility or yours? If you don't want to think for yourself, buy packaged meat and watch videos of other people shooting. I have seen a few folk who want a custom rifle that will shoot to 1000 yards, expecting the rifle to 'produce' zero wind drift ("I paid good money for this, wind drift should not be an issue"). At some point you must take responsibility for your build, unless you also

want the smith to be there to read wind drift for you and perhaps tuck you in at night!

Please also remember the advice given here about final assembly. Some smiths may baulk at my suggestion that you disassemble the rifle, inspect everything, and then reassemble the rifle as per the steps within this book; however, I believe that the process of double checking should be viewed simply as step 1 of long term rifle maintenance.

If you are a gunsmith, you can also benefit from this advice by making sure that your clients clearly understand what services you are offering and who is responsible for what. If for example you cannot offer an accuracy guarantee because you find local barrel quality is hit and miss and that you simply cannot wear costs, that is fine; but you need to stipulate this at least verbally to clients if you are going to be working together.

As a last note on custom rifle set up, I would like to again reiterate the importance of barrel twist rate selection. Try to avoid the extremes of both overly slow and overly aggressive twist rates when selecting a custom barrel - especially if shooting a very high velocity cartridge. It is all very well for some expert to state that *X* aggressive twist rate is ideal on some computer generated calculator - but in reality there are other variables to take into consideration. And besides, let’s say you do adopt an aggressive twist rate and then find that you cannot obtain the bullet you intended to use due to supply problems. A more flexible twist rate will allow you to experiment with a wider range of bullets.

Summary of Key Points:

- Communication is a key factor: establish the role of the gunsmith versus your role in the project.
- Use job checklists.
- Apply common sense to twist rate selection.
- If there is any doubt after receiving the rifle, disassemble and then reassemble the rifle to check all critical points.
- A good gunsmith (or apprentice) can make mistakes - his popularity adding job pressure/stress.
- The difference between a good gunsmith and a ‘chop shop’ is that the ‘chop shop’ owner doesn’t give a …..
- Ultimately, the final result is partially your responsibility.

Step 8 - Assess rifle accuracy

If all has gone well, the rifle is showing some promise and is either shooting in optimal fashion or at the very least is producing triangular groups of around 1 to 1.5” at 100 yards (with our mock bedding).

If the rifle is shooting well as is (without mock bedding), you will have to make a decision: to bed or not to bed. My general recommendation is that wood stocked rifles should be bedded due to eventual stock compression. Ali chassis rifles that are shooting straight can be left as is. Although sometimes these will develop excessive play through movement of the action in the chassis. This causes the chassis to gradually take on a polished finish which in turn leads to more movement. The Tikka T3 can be left as is, the synthetic stocked Browning A-Bolt with its glue gun bedding can also be left as is. Laminate stocks can in some instances become crushed over time. It is up to you to utilize your common sense and discretion, as to whether

your rifle will likely remain stable over time or whether it will benefit from epoxy bedding (or glue and screw bedding an aluminum chassis, if this approach has not already been adopted).

Personally, I bed or glue and screw just about everything. But there will be those of you who are too nervous to delve down any further, if the rifle is accurate. That is fine by me - I certainly do not wish to push you into something you are not comfortable with. Perhaps when you are ready you might like to try your hand at bedding an old .22. Therefore, those of you who wish to leave your rifle as is can now move on to general maintenance.

If the rifle is shooting well or at least in a uniform manner with mock bedding, you can now move onto full epoxy bedding.

If your rifle is shooting poorly, you will need to carry out further testing and rifle work. It is important that you remove yourself and your shooting technique as a variable. If you have plenty of experience with rifles of the same recoil level and you know that you are a good shot, then you will know that the rifle is at fault. But if you are unsure, you may have to borrow a rifle of proven accuracy or ask a competent friend to shoot your rifle. It is so important to remove human error as a variable. We can generally deal with one or two variables, but multiple variables (Is it me, is it the rifle?) will really do our head in. It is extremely important that you steadily build a good level of confidence in your shooting abilities to get you through such times. But do not confuse confidence with pride!

Provided human error has been removed from the equation, the remaining variables include the bore and ammunition. These branch out into subsets of variables, so we need to work towards simplicity in order to avoid further confusion.

I have already mentioned using factory ammunition to establish a base line along with hand loads. If you do not hand load and accuracy is poor with your factory test loads, you will need to try and obtain a different brand or style of factory ammunition to test. You may end up going through more than three test lots of ammunition. There is no point burning off whole boxes of ammunition. Simply set about continued testing and observe trends. If the rifle is still producing groups of around 3” or larger, the bore is the problem.

If you are a hand loader, you will want to pursue testing a bit further. You can try a different projectile plus a range of seating depths, along with factory ammunition as a base line. Again, keep your tests simple and look for basic trends. There is no point firing of boxes of projectiles. If the rifle is shooting around 3” or wider and you have taken every care with hand loading, then the bore is at fault. If you are unsure of your hand loading skills, either seek help or increase the test range of factory ammunition from one to two or more brands.

Ultimately, we need to ascertain whether our accuracy problems are related to the barrel. Sometimes there may be a flaw in the action, but unfortunately this is something that we may not discover until we have exhausted the bore as a variable. This is discussed in more detail further ahead.

Fast versus slow fouling bores

A fast and heavy copper fouling bore is somewhat easy to identify. We shoot the rifle, it groups OK to begin with, followed by a rapid deterioration of accuracy. We unload the rifle and inspect the muzzle and can see a very heavy coating of bright orange copper fouling and we can plainly see the correlation between poor accuracy and excessive copper fouling. **If your bore is showing great accuracy potential but then loses accuracy after perhaps a dozen shots, it can be well worth experimenting with bullet coatings** to reduce friction rather than

continually lapping the bore. Besides Molybdenum Disulfide (moly) bullet coatings, one of the most useful products of recent invention is Hexagonal Boron Nitride or HBN as it is now known. This dry lubricant does not cause corrosion which can occur when using moly if the bore is not duly attended to.

If the bore of your rifle is simply displaying heavy copper fouling and poor accuracy either immediately or after just three shots, it is unlikely that bullet coatings will help. The bore of such a rifle may instead need further lapping which may also include fire lapping.

A slow fouling bore is a tricky customer. The trouble with this type of bore is that it can take up to a dozen shots or more before the rifle shows any signs of good accuracy. If you only take one dozen rounds of ammo to the range, the rifle may fail to hit its stride within the shooting session. Worse still, if performing load development, a proportion of your loads (the first dozen shots or so) may all be false reads.

Yet another problem with the slow fouling bore is that it may actually appear to be producing a ‘nice’ light layer of copper during muzzle inspections. But what we do not realize, is that this particular bore needs a heavier buildup of both copper and carbon fouling before it can properly grip and guide the bullet.

Whether the problem stems from a lack of dimensional uniformity or simply as a result of the nature of the individual bore, it is easy to miss a slow fouler. To test whether your rifle is a slow fouler, you will need to put at least a dozen rounds of ammunition through it at a slow to moderate pace, then leave the rifle to fully cool before commencing a fresh round of testing.

If you do discover that your bore is what I call a slow fouler (even if there is evidence of moderate copper fouling within the first few shots),

then cleaning regimes will need to be modified to suit (see maintenance section).

Summary of Key Points:

- Fast fouling but accurate for first dozen shots: consider bullet coatings.
- Fast fouling but inaccurate: continue lapping / possible fire lapping.
- Slow fouling bores are more difficult to recognize.
- If your bore is a slow fouler- change cleaning regimes accordingly.

Barrel stress and double grouping

If the rifle is producing double groups or laterally stringing in a very consistent manner, there may have been a problem with the heat treatment. In other words, the barrel steel is of a poor or uneven temper. But first we have to determine whether it is the barrel itself or its bedding that is at fault.

If your rifle was previously bedded and the action is of a square design with straight, parallel side walls (e.g. early Tikka rifles), the bedding may be pinching the action, preventing the rifle from recoiling and returning to battery. The first clue to this pinching is a very tight fit during rifle dis-assembly and assembly. If this is indeed the case, then we need to take steps to isolate whether the bedding is causing the double grouping.

Step 1: Relieve the side walls of the bedding. Take a fresh piece of 180 grit sand paper. Sand one side of the bedding and count each pass. Do 6 passes (12 times back and forth). Change to fresh sand paper and do the other side and count your 6 passes again. Lube the side walls, then check fit. If the fit is still tight, keep going.

Alternatively you can blast the sidewalls of the bedding with controlled passes using a glass bead blaster, but you will need to tape over the bottom of the bedding surface to protect it from bead blasting. The fit needs to be loose enough that the rifle can recoil and return to battery.

Step 2: Grease the metal work and assemble the rifle. In this instance you will be using the grease as a lubricant to help the rifle return to battery after each shot. Torque action screws no more than 45 inch-lbs. Also check that the barrel is free floated and the stock is not interfering with the barrel.

Step 3: Observe group behavior. Fire one group at an even pace. Fire one group at ambient temperatures. By ambient, I really mean letting the barrel cool right off between shots to within a degree of ambient temperature.

Step 4: Conclude work. If the bedding relief worked, then obviously the bedding was at fault. If not, the barrel is suffering the effects of a heat treatment problem.

Once I have thoroughly identified a barrel as suffering heat treatment flaws, I generally bin it. If your budget does not allow you to do this, you may wish to employ forend pressure point bedding as a long term solution. I would however suggest that rifles bedded in this way be limited to 300 yard shots.

OK, so what if the rifle was not bedded or has been mock bedded?

If the rifle was not bedded, I would suggest mock bedding. You will need to make sure that your mock bedding is fully rigid. The same applies if the rifle has already been mock bedded and in this instance, you may have to start over to ensure that you achieve a rigid mount bedding. Remember, we can utilize rigid mount or return to battery style bedding, but not something in between that allows the action to move from pinch point to pinch point! I would also suggest using double syringe epoxy for the most rigid "glue it and screw it" type mount rather than auto body filler when addressing the double grouping rifle.

Again, check that the barrel is free floated and the stock is not interfering with the barrel.

If the rifle has been mock bedded (or once you have the rifle mock bedded), you will need to perform fresh tests. Again, fire a fouling shot or two, then proceed to fire a group while allowing the barrel to fully cool to ambient temperatures between shots. Find a book to read, find something to do - let it fully cool between shots. After this, fire a group at your normal pace. If the rifle only shoots well at ambient temperatures, then the barrel is flawed.

If you wish to pressure point bed your rifle rather than replace a flawed barrel, you may wish to perform further testing to establish the ideal pressure. If I am pressure point testing, I prep the forend tip of the stock and barrel for auto body filler. I then place a shim the thickness of two business cards in the area of the rifle action and set about mock bedding the last inch of the stock forend. After the filler has cured, I pull the job, remove the business cards, and reset the action in place. Without the business cards, the action will drop lower and place the barrel under a degree of pressure at the tip of the forend. I can then commence testing but will have to keep barrel temperatures low to prevent vertical stringing. If I need to, I can quickly remove the bedding

and retest a different pressure by varying the packer height under the action, rebedding the forend tip and retesting.

It is up to you whether you perform a mock test at the forend tip or simply get straight into bedding the forend tip with epoxy resin. If you have a wood stocked rifle and employ pressure point bedding, you will need to check the zero of the rifle on a regular basis to make sure that the wood has not shifted over time, effecting group size and POI. Please bear in mind that pressure point bedding a flawed barrel is far less than ideal and should only be employed if your budget is severely limited.

One last option is a barrel de-resonator. In my experience a de-resonator can only achieve so much, but can be the difference between .7 MOA double groups and sub .5 MOA shooting. The key factor here is to understand that a de-resonator is not a cure all. A de-resonator can help with minor flaws, it cannot perform miracles. I also think that there is some room here for those of an entrepreneurial mind. A barrel of good temper is still prone to harmonic likes and dislikes and I believe there is room for a tunable de-resonator. Browning had success with the adjustable BOSS muzzle brake, but the price was extreme noise levels. A de-resonator comes at the price of increased weight, but I am sure that with some cunning engineering de-resonator units could be made relatively light and compact. The de-resonator could then be shifted and re-clamped along the barrel in an incremental manner to fine tune loads. Food for thought anyway.

The Remington M700 VTR rifle with the triangular barrel has been particularly bad since its introduction; not for heat treatment, but in the way it disperses heat unevenly. The double grouping is sometimes small enough (around .6 MOA) to be of little consequence and the rifle can be left free floated. In other instances, accuracy can be rather poor. My preference is to pull the barrel and start over rather than try to pressure point bed the triangular VTR barrel.

The brake design of the VTR does nothing to help accuracy either, venting gases in one direction without opposing vents to counter balance forces. It surprises me that this model of rifle has stayed in production for so long.

Fire lapping

I tend to utilize fire lapping as a last resort on the rough or dimensionally unsound bore. Some folk are content to fire lap every barrel they own, but for me it is a make or break situation. When I fire lap, it is going to go one of two ways.

Fire lapping involves rolling projectiles in aluminum oxide grit, then firing them through the bore. Most people think that the goal of fire lapping is to smooth the bore but this is not the sole function of fire lapping. By lapping at high pressure with a coarse grit the hand loader can open up bore dimensions at the chamber end of the rifle. As the projectile travels down the bore, the grit breaks down and leaves the projectile, leaving the muzzle tighter than the chamber. We can also remove burrs and perhaps tidy up malformed lands.

There are various fire lapping kits on the market. I tend to use our own buff grit, as we purchase this in bulk for stainless work. The following information will not be the same as what you would normally read about fire lapping. As per usual, the information here is based on our own exhaustive testing.

To begin with, I like to use bullets with driving bands (eg Barnes TSX) for fire lapping if at all possible. This is because the low spots between the driving bands are great at holding grit. If I do not have access to Barnes (or driving band style bullets), I roll standard Hornady Interlock projectiles between a coarse file and a block of steel to create a knurled surface. I also lube the bullet with lee wax, but the layer of lube is

extremely light and barely perceptible. I use this as a sticky layer. Following this, I can then roll the projectiles in grit, between two pieces of steel.

I prefer to work with 180 grit with 240 grit as my upper limit. I have experimented with fine grits but have found that if the bore is still not fully sound, the fine finish can ruin accuracy as per the research I have already described.

Projectile very lightly coated in wax prior to rolling in grit.

When assembling fire lapping handloads it is important to flare the case mouth slightly. You may need to borrow a second set of dies to do this. As an example, if I want to flare 7 mm cases, I will use a .30 caliber die with a suitably tapered .30 caliber expander button. I then flare the start of the case mouth, and check the fit of the case in the rifle

chamber to make sure I have not gone too far. If all is well, I can then set about priming, charging and seating the grit impregnated bullet.

I tend to use fairly stout loads when fire lapping, utilizing the pressure to help swage bore dimensions. If you are new to fire lapping, you may wish to use reloading manual start loads. Those of you who are more confident, may wish to test incremental loads, watching for pressure signs which will come early.

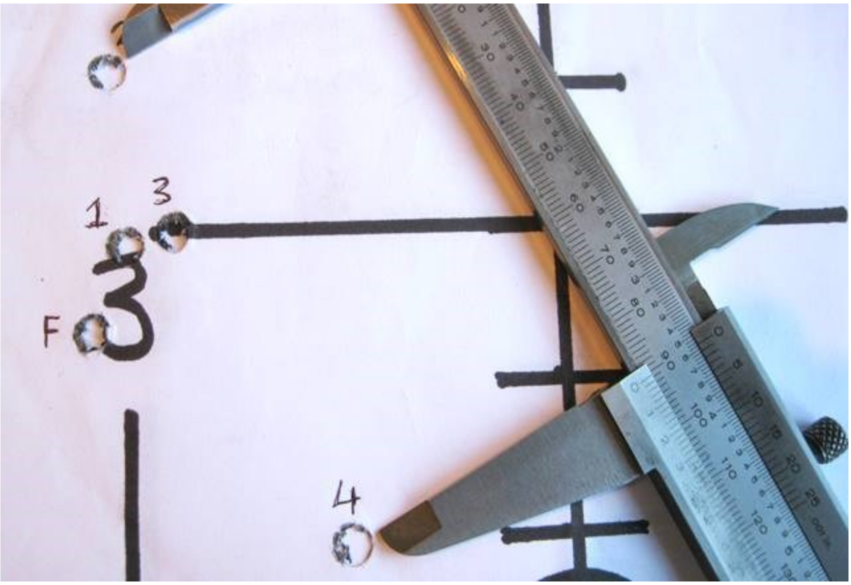
I generally make up six fire lapping cartridges. I wear safety glasses during testing, in case something foul should happen, not that it ever has. I lube the bore with Long Life but have also used machining cutting fluid (Rapid Tap brand) as a lubricant.

I clean between each round and re-apply lube, then after I am finished, I hand lap one final time, then test shoot. In most instances this will fix a dud factory rifle bore; and the results can be extremely dramatic: from 3” groups to a half inch or less. This is the greatest feeling - finally nailing that difficult bore.

Roll the projectile between two pieces of steel (or hard material) to help the grit impregnate. I have laid out roughly a dessert spoon of grit for this job.

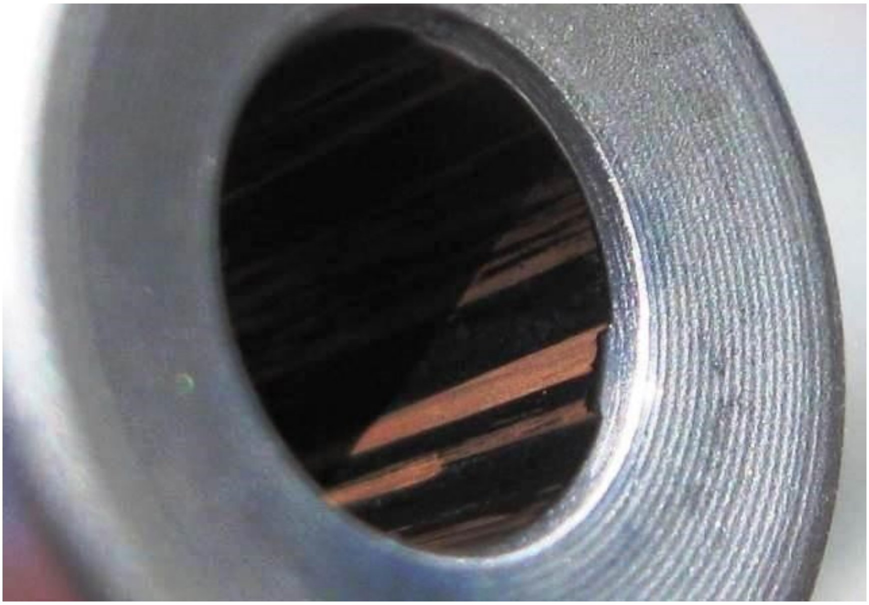
If you do not have access to driving band bullets, you can use a file to knurl your own, pressing down on the file and rolling the projectile across a block of steel.

Occasionally, fire lapping will make a problematic bore worse. This tends to be rare, but it does happen. If this happens, you have reached the end of the line, and it is time to look at barrel replacement. If you have followed from the beginning of this book through to now, you will hopefully have avoided bedding the rifle and putting a great deal of time into it. If you have read my first book, you will have a good action and so it will be worth re-barreling, allowing you to move on.



A group produced from a rifle suffering from severe copper fouling. Fire lapping shrank groups down to .5" at 100 yards with factory ammunition.

As I have suggested, some folk fire lap everything as par for the course, new or second hand. Some target shooters also fire lap custom barrels. I am not in this habit myself but I cannot find great fault with the premise, especially with the results that are often obtained. The big issue generally is throat wear.

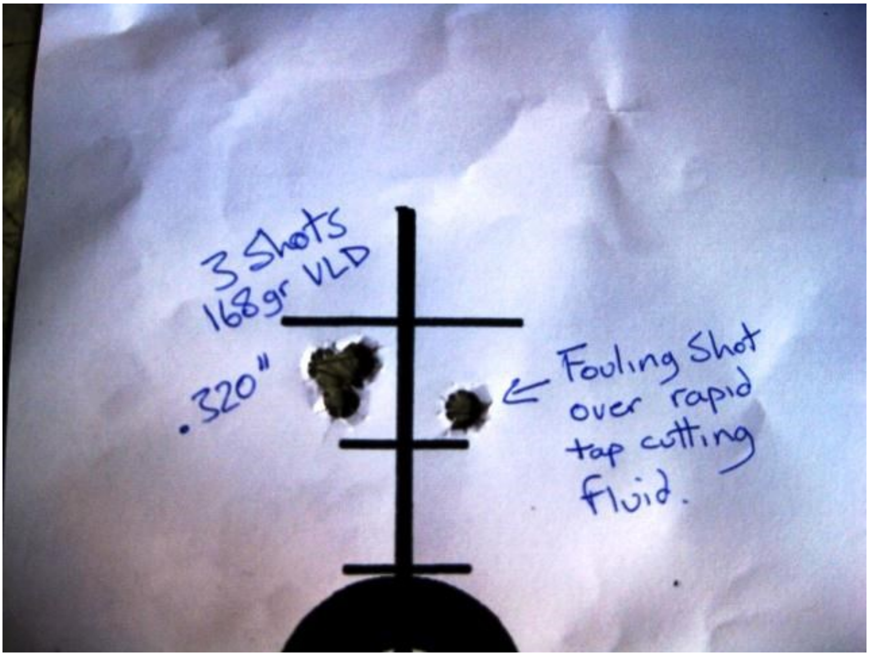


This barrel produced heavy fouling after three shots and accuracy was poor. The final solution was fire lapping which fortunately fully optimized accuracy. Please note, the level of fouling seen in this photo would be acceptable for anything bar competitive shooting, if the rifle had fired 30 or more shots.

To put throat wear into perspective: yes, fire lapping can shift the throat forwards a touch, but it does not create pits or fire cracks. It simply shifts the beginning of the rifling forwards and may change the angles a touch which can complement VLD bullet designs. If we are realistic about this, a slight shift in the throat should be of no major concern. To this end, I cannot fault those who engage in fire lapping as a standard procedure.

In the extreme, I have heard of target shooters fire lapping new bores, then removing the barrel and setting it back a touch followed by fresh chamber reaming. Here again we get into a situation of the target shooter needing a low fouling rifle of optimum internal bore

dimensions. Whether or not he understands the exact function of his work is irrelevant, the end result is an accurate rifle.



A finicky Remington Mountain rifle in 7 mm Remington Magnum. This re-barrel was on its last chance when I fire lapped it. The rifle went from 3” at 100 yards to .320” after the lapping session and has stayed in the .3” region ever since. I was also experimenting with machine tool cutting fluid for breaking in barrels at this time.

Summary of Key Points:

- Assess accuracy by observing shape of groups - not just size.
- Try to isolate the barrel as a variable, making sure that the bedding (including mock), ammunition and shooting technique are optimal.
- Use low grit fire lapping if necessary.
- If the barrel is a dud, it can be replaced before committing to epoxy resin bedding.

Lead lapping

Lead lapping is a method utilized by gunsmiths but is a practice I am hesitant to recommend to DIY operators for reasons I will explain.

To pour a lead lap, we can use a completely worn out bronze brush (without bristles) or brass jag and apply a patch of tape around the cleaning rod just behind the worn brush to act as a plug.

The rod is then placed in the (clean) barrel of the upright rifle and passed through to the muzzle so that the tip of the brush or jag is flush with the muzzle. A small pot of lead can then be heated for the lap. The muzzle of the rifle must also be lightly heated otherwise the lead will set on contact before it penetrates the bore. Following this, the hot lead can be poured into the muzzle of the barrel slowly (while making sure the rest of the rifle is protected from hot lead). The lead will set almost immediately. Once the lead is set, the rod and newly formed lap can be pushed out of the muzzle and surplus lead removed from the tip of the lap (where it flowed out of the muzzle).

The next step is to check bore dimensions. Insert the rod and lap through the chamber, carefully rotating the lap as it is presented to the rifling with the very lightest of pressure. It is possible to line up the rifling grooves in the lap with the lands and grooves of the bore and then start the lap into the bore. The lead lap can then be used to check for major tight spots prior to any lapping. Minor tight spots will not be felt due to the contraction of the lap after it was formed during cooling.

Following the checking phase, the lap can be lightly and evenly coated with lapping paste or very lightly oiled, then very lightly and evenly coated in aluminum oxide grit. The next step is to feed the prepped lap into the chamber end of the rifle, again aligning the rifling grooves in the lap with the lands and grooves of the bore. The bore can then be lapped to remove any tight spots towards the chamber end of the rifle, working towards either a dimensionally uniform or slightly muzzle tight bore.

Such a lap does not jam and displays no problems as far as feeding it through the bore is concerned. The greater problem is that a lead lap can be very aggressive and shift the throat forwards in a severe manner, greatly increasing bullet jump. It is also hard to maintain a fine and even grit layer on a rifled lap as opposed to a concentric projectile (fire lapping). With regards to bullet lead and bullet jump, an experienced gunsmith will lead lap a bore before the chamber and throat of the rifle are cut - or set the barrel back and rechamber the barrel if lapping post production.

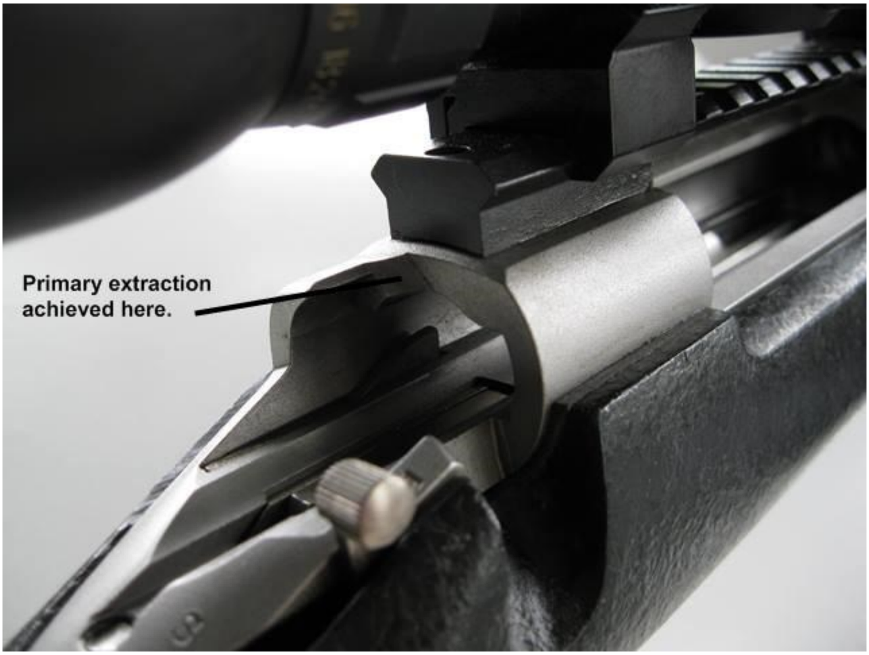
Gunsmiths may wish to experiment with these procedures but my advice to end users is to refrain from lead lapping due to the risks described. That said, the enquiring DIY mind may wish to experiment with lead lapping on lower value guns.

Action problems and flaws

Action flaws can occur with all brands. I have even seen very high end rifles with action flaws, brand names can mean very little these days.

As I type these words, my favorite brand of rifle is going through a tough patch. The M700 is a thoroughly well designed action, the fact that its basic footprint is copied by custom rifle makers should speak volumes of the design. But of late there have been a few problems on the shop floor, and we are seeing the occasional slip in quality control. In a few instances, the bolt handle has been soldered on at the wrong location. The bolt handle of the M700 is responsible for primary extraction, and if it is not located in such a way that it cams against the action in an optimal fashion, extraction of fired cases can be difficult. Rough chambers have also occurred which add to extraction problems. The end user may have great difficulty discerning whether extraction problems are caused by a rough chamber or a primary extraction problem. Broken extractors are less of a problem but can happen from time to time. Bolt play is yet another problem that can occur (and is covered in my first book). I have been very lucky over the years, having had very few problems with the M700. But just because I have had great luck, it does not mean that I can ignore the facts and waffle on within the pages of my books, as if Remington staff are incapable of making mistakes.

Receiver threads cut off center is yet another problem, resulting in an off center barrel. This can occur in high end rifle designs, including those of European manufacture. Again, brand names can mean little these days.



Primary extraction point on the Remington M700 rifle design. It pays to keep this area lubed to minimize wear.

Getting to the point, in each of these cases the rifle must be sent to a gunsmith. I do have a DIY fix for a rough chamber, but this method is as rough as the initial workmanship. The method involves taking an empty cartridge case, drilling out the primer pocket, and thread tapping it. A length of ¼" or 6 mm thread stock is screwed into the case with a nut locked against the rear of the case. A power drill and lapping compound seal the deal. Such a method can actually work in an optimal fashion, but again it is very much a rough and ready approach and not recommended, unless your location is such that you have no way of utilizing the services of a gunsmith. It is a last resort - a Foster bush remedy special!

If the action of your rifle is flawed in such a way that it needs blueprinting, you probably will not know this during your testing. It is the mysterious variable *X* which cannot be fully explored until the rifle action is in a truing jig and all tolerances, including the bolt have been fully examined. If you have a problem rifle, my advice is to put your attention into the barrel and mock bedding as variables until these avenues are thoroughly exhausted - including fire lapping. The reason for this is because the barrel will most likely be binned during the blueprinting process, due to the fact that the thread of the barrel may not be in unison with the freshly tricked up threads of the action. If you blueprint, you will in essence be starting over. So to reiterate: if the rifle is being a complete mongrel, keep going - keep working until you have exhausted all avenues. If the result is failure, start over, seeking the help of a gunsmith.

Heat treatment flaws are the very worst. Your smith will not be able to determine whether your rifle action has a heat treatment flaw until he has exhausted action truing, re-barreling (often two to three times), bedding (and sometimes re-bedding), along with extensive load development. Such situations are extremely hard on a smith, absorbing countless hours and costing a great deal of money, while causing immense personal stress as he questions his abilities in the face of imminent failure. Fortunately, action heat treatment flaws are not that common. The chances of you encountering a heat treatment flaw are low. If the action does have a heat treatment flaw, you will need to discuss options with your gunsmith. An old hand may attempt fresh heat treatment. Another method is to anneal the steel, but not past its critical point at which the structure of the steel completely changes and loses its strength. Those of you who are familiar with heat treating small parts by hand will remember that the first heating and quenching phase will set temper, but that by reheating to a straw color the part is made less brittle. It is in essence made into a tough workable part. The same principles can be applied here without ruining temper. That said, the

application of heat for stress relief needs to be very carefully monitored while the treatment needs to be gradual and thorough. Regardless of the various techniques a gunsmith may be able to utilize, many smiths will likely suggest that you purchase a new action as a means to save time (experimenting) versus costs.

Summary of Key Points:

- Action flaws relative to accuracy are not usually found until the bore has been exhausted as a variable and rifle has been sent to gunsmith.
- Other flaws such as primary extraction should be addressed by gunsmith.
- Action heat treatment problems can be difficult to rectify.

Further thoughts

Every once and a while I will trick up a factory rifle including fire lapping, only to find that the best I get out of the rifle is groups of around .75 MOA accuracy, and the rifle still producing fairly heavy copper fouling. I have found that by simply allowing the rifle to shoot this way for a while without frenetically chasing loads or potential solutions, these rifles will often steadily come down in group size over time. This tells me that regardless of the work I have done, the break in period is still ongoing. I will reiterate here that this is generally a factory rifle/rough bore scenario. If the rifle is a high end rig with a highly polished bore and won't go below .75" no matter what I do, there is little more that can be done. If I am doing the build, I need to pull the barrel and start over and make it right for the client.

At this point we need to take accuracy criteria into consideration. If the rifle is to be used out to extreme ranges, .75 MOA is not ideal. But if the rifle is (for example) chambered in .308 Winchester and is going to be used out to a general maximum range of 600 yards with the very occasional 700 to 800 yard plinking session, .75 MOA is more than adequate. If the rifle is to be used for general hunting out to 300 yards, 1 MOA is fine. You will need to define goal accuracy for yourself. My goal accuracy tends to depend on the client. If I am tricking a basic light sporter for 300 yard work, I aim for .5 to .75 MOA; whereas I like to get the long range rigs below .5 MOA. These may be unrealistic expectations for you, depending on your experience level and base quality of the rifle. In other words, try to not put too much pressure on yourself or set unrealistic expectations. Extreme accuracy is a good goal, as it challenges us and we are at our best when facing challenges or adversity. But there is a balance.

Finally, if you are tricking up a true long range rig you will need to set high expectations. There are a few shooters who expect instant results at long range without having to work on rifle accuracy. These types reason that we now have the technology, so the kit should be able to do this straight out of the box; no need to read wind either, just point and shoot. Well, the ‘extreme accuracy out of the box kit’ part is slowly becoming possible for those who have the coin. But for most folk the bottom line still is - you have to get off your jacksy and make it happen! Once you move from general hunting to long range precision shooting, you need to have all your ducks in a row, and it can be a complex, fully engaging activity.

Yes, there is some pretty good kit out there, but they still keep making stupid people too.

Rifle bedding with epoxy resin

The following section will focus on the practice of rifle bedding. The reasons for bedding and its mechanisms, including the issues of pinched versus return to battery bedding have been covered in my first book; so too have topics of rigid mount versus return to battery bedding. Having covered this theory, we are now addressing the basic how to aspects of bedding.

To pillar bed or not, that is the question

I want to address this issue first because it tends to create a lot of confusion. We need to be clear about job planning before we proceed.

Pillar bedding tends to be greatly misunderstood. The occasional gun manufacturer throws a couple of pillars in a stock and declares the rifle pillar bedded. If you have followed my earlier work, you will know that this is not pillar bedding and is instead, a rifle with a couple of pillars fitted - big difference.

Pillars should basically be used where there is a risk of stock compression either before or after bedding. Pillars can also be used to remove stock flexing during the actual bedding process.

I use pillars when bedding wood stocks, glass over foam stocks and some laminates (if I am dubious as to the strength of the laminate). I don't generally use pillars on plastic stocks, apart from the Tikka T3 tang which has a hole passing through the rear face of the rear action screw hole into the butt stock, a leak point for bedding compound. There are also benefits to pillar bedding other brands of plastic stock which we can address later.

There is no need to pillar bed rifles with aluminum chassis as these already have pillars. If you have a Mauser action, you will see that the front of the floor plate already has a pillar built into it. This is a bit different to other rifles in that there needs to be a slight gap between

the pillar and rifle action after bedding. If there is no gap, the action will sit on the pillar instead of the bedding. In other words, the stock is left flopping around between the action and floor plate. The tang of a Mauser can however be pillar bedded. You will find that some Mauser rifles have a steel pillar in the tang, some do not, some have been lost. The Mauser is what I call a height critical action due to both the pillar and magazine box design. This is explained in further detail in the bedding section.

There are various ways to set about obtaining pillars. Those with access to a machine shop will custom make pillars to suit. There are also aftermarket type pillar kits. I am not a great fan of some of the current pillar kits, because the pillars are so bulky that the DIY user is asked to drill out almost the entire tang of the rifle to fit the pillar. This seems counterproductive to me - weakening the tang to fit the pillar

An Oberndorf Mauser. Note the pillar built into the front of the floor plate.

I have my own method for DIY users. I thoroughly recommend the use of an aluminum arrow shaft. This can be cut to size with either a hack saw or an angle grinder, then trimmed with a Lee case trimmer. Yes, the old Lee case trimmer strikes again - a simple yet effective tool. You will need to use an undersized pilot on the tool; and if you need to, you can wrap tape around the pilot to bring it up to size. This will allow you to trim each end of the pillar square. Some of you may wish to contour the top of the pillar to suit round bottom actions; this is entirely up to you and your skill set.

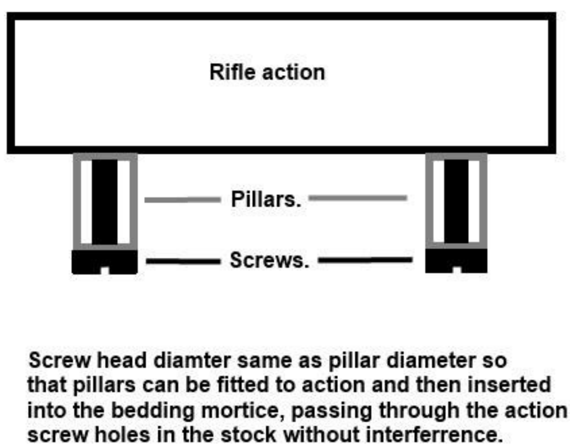
An aluminum arrow shaft pillar in a Howa wood stock. It is countersunk (action will not touch it) but is still just proud of the stock.

By using aluminum arrow shaft, there is no need to drill large holes into your gun stock to fit the pillars. This is much easier on the nerves for the DIY player (actually for most of us). The shaft may be thin but once it is

set in place, the combined strength of the stock, bedding compound and pillar will allow you to tighten action screws to 55-60 inch-lbs.

The real question is how to fit the pillars, and this is where most folk come unstuck. There are three ways to fit pillars.

1. The first is to use a machined action screw that has a head diameter which is the same diameter as the pillar. With this style of pillar system you then insert the action and pillars into the bedding compound at the same time. This method cannot ensure that the stock is not stressed during bedding (bungees) but it does ensure a metal to metal fit of pillars which looks very presentable. This system works, but for most DIY users, unless they have access to a machine shop or one of the ready-made kits, it is not practical.



A diagram of pillars with matching screw head diameters, machined to size.

2. The second method is to epoxy the pillars in place (double syringe resin), then bed to the pillars. This is a simple method and ensures that the action has to sit on the previously fitted pillars, the stock cannot flex. This can be very useful when dealing with highly flexible plastic stocks. It is important to understand that if you flex a plastic stock during bedding, the stock will always be under stress once the job is completed, having a detrimental effect on accuracy.

So, what's the down side? With this method, there is always going to be some seepage of compound between the action and pillar (especially a square pillar and round action). The shim of compound is generally so thin that it is weak and eventually, the compound will break away in this area, leaving two rings of steel countersunk. In other words, after the brittle rings of compound break away, the pillars will not touch the action. This is purely an aesthetic factor because the rest of the action is supported. The action sits on the compound, the compound has cemented the pillar in place (provided it was proud of the stock). The epoxy also keeps the pillar in place.

The countermeasure to the compound being brittle in this area: lay wet compound on the rifle action a few moments prior to bedding, then apply a bird's nest of finely chopped carbon fiber or fiberglass onto this area, pat the fiber down until it is fully wetted and absorbed. This will form a super strong matrix and helps build thickness in this area of the action screws where the pillars will sit.

3. The final method is the easiest for DIY users. With this method, we simply countersink the pillar. Because of this, the height of the pillar is not critical. As long as one end is square and is epoxied in place, so that it meets the floor plate, the top of the pillar can do as it pleases.

The trick with countersinking is to grind material from the stock, then sit the epoxied pillar just proud of the stock inlet. This will ensure that both the epoxy resin and bedding compound have access to the pillar. When

bedding, the rifle will be brought down onto plasticine dams and set reference points rather than sitting on the pillars. Once the job is complete, the pillars will be well hidden.

Forming a carbon fiber matrix. I have also used wild pig mane in the past - makes for a little something special.

If you have purchased a rifle with an HS or Bell & Carlson brand stock with aluminum chassis, you will find that you have no choice but to utilize countersinking.

The Hogue rifle stock comes with integral pillars. During bedding, you have two options: Bed to the pillar, in which case I recommend building a fiber matrix to prevent creating a brittle layer of compound. The second option is to grind the pillar down a touch so that it is counter sunk.

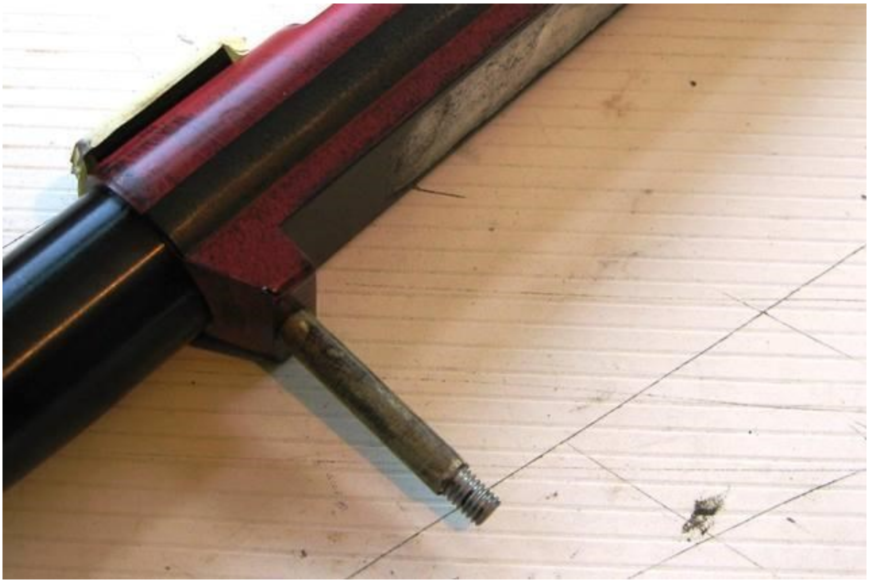
The downside of countersinking is that if the stock is of a flexible design, you may flex the stock during bedding (when applying bungees). Just firm bungee tension is the key. If you are unsure, practice setting the bungees in place before pouring bedding compound into the stock. If your rifle has a very heavy barrel and you feel that you need to crank your bungees to keep the action in place, utilize a forend pad (plasticine) in the rifle stock instead and carefully fit and align it with other dams. This will prevent counter levering.

Again, bungee tension needs to be just firm with this method. Enough to keep the action in place without stressing the sensitive stock. By the same token, if you go too loose, you may find that the tang of the action

rises during curing and sucks air into the bedding job. Your common sense will get you through.

You can still use carbon fiber with countersunk pillars if you want to. Tricks like this can certainly help keep you out of trouble. I tend to use the countersink method because we sell our own brand of bedding compound, so I like to mimic the DIY user to some extent in order to stay attuned to his needs. But I also utilize method 2 with carbon fiber.

One final aspect of pillar bedding that we need to address is the question of the role of pillars in actions which have the front action screw located within the recoil lug of the rifle. I generally recommend that the underside of a recoil lug should be taped during bedding to provide relief in order to avoid a pinched bedding job. But if we relieve the underside of a recoil lug, this will prevent the pillar (or countersunk pillar and bedding) from coming into contact with the action and seems to defeat the purpose of having a pillar. We need to have a good think about this because there are two ways we can approach the issue.



The above Howa action is prepped for bedding. I have placed electrical tape on the bottom face of the recoil lug. After bedding, once this tape is removed, the bottom of the lug will be floating.

So let's have a think about this. If we wind the clock back and study Mauser design theory, the front pillar was never designed to engage the recoil lug. Instead, a small gap between the lug and pillar always ensured that the action could be screwed down into the stock. Without this gap, the action would pull down onto the floor plate and pillar, leaving the stock floating in between. We can employ the same principles when bedding modern rifles, even though the floor plate/pillar assembly differs to a degree. As long as the pillar is in place and our bedding job is strong, we will be able to set our action screws to torque settings of 55-60 inch-lbs without fear of stock compression.

As an alternative, if the bottom of the recoil lug has a large surface area (e.g. Howa and older model Sako rifles), we can omit tape relief under the lug; but if we do so, we must understand the potential

consequences of this action. One of the primary concerns after bedding is that during routine maintenance and handling we can accidentally, and generally will, scrape the rifle bedding during reassembly operations. If the bedding is scraped, the crumbs tend to gather under the recoil lug and jack up the action; this will ruin bedding tolerances. Other debris can also become trapped under the lug. My advice is that if you wish to have the underside of a large lug in full contact with the bedding, it is best to chamfer and polish all edges of the lug after bedding. This will help minimize scraping during dis-assembly and reassembly operations.

Both of the pillar/lug methods I have explained here can be utilized to produce optimum results. I generally recommend the tape relief approach to end users as this is usually a trouble free, foolproof approach, based on very old and very well established theory and practice. Nevertheless, you have the information here and hopefully a clear understanding of consequences, allowing you to make your own decisions. I will go over this again in the bedding instructional section of this book, just to make sure you are doubly clear on the subject.

Hopefully you will now have a handle on the role of pillars. All we want from a pillar is for it to allow us to crank up the action screws without fear of splitting the stock in half at a later date. With flexible stocks, we can bed to the pillars to minimize stock stress. Once pillars are in place, a stock is less sensitive to action screw torque, allowing us to utilize 55-60 inch-lbs settings.

Summary of Key Points:

- Pillars can be used to either prevent stock compression or minimize stock flexing during bedding.
- There are three basic methods of pillar bedding.

Barrel knox bedding

This is yet another confusing issue for shooters and one that we need to address before we set about bedding. In my first book, as well as within our bedding instructions, I recommend bedding the beginning of the barrel channel in order to help alleviate action stress. Most of the barrel will remain free floated apart from the first part of the barrel, also known as the knox. I do not generally recommend full free floating unless there is no other option. If a rifle barrel is very heavy, it can potentially place stress on the action if the barrel is fully free floated. I find any stress of this nature can make a rifle finicky with sweet spots reliant on the most exacting of powder charges and so forth. Bedding the knox can also act as a harmonic dampener for very light barrels.

On plastic stocked rifles barrel channel bedding is critical. This is because the plastic stock has a weak point between the action and barrel in the recoil lug cut out. Even if the forend is stiffened, this flex point remains. It is therefore critical to bed the barrel channel as a reinforcing bridge between the action area and the forend of the stock.

The trouble is, serious shooters will ask the question: “Does this mean that I have to fully re-bed the rifle and barrel channel each time I re-barrel the rifle?” The short answer is no.

My recommended procedure is to bed your action and knox, as is appropriate according to our instructions. Once the bore is worn out and being replaced, you can then free float the knox by grinding away the bedding in this area. If you have a plastic stocked rifle, you only need to remove enough of the barrel bedding to free float the barrel, retaining a good portion of the original barrel bedding as reinforcement for this section of the stock.

Following this, test the new barrel and see how it shoots. If groups are optimal, there is no need to re-bed. If the rifle is generally accurate (.6

to 1”) but is finicky, you may wish to re-bed. If groups are very wide, look for other factors such as the bore itself. However, nine times out of ten you will get away with a fully free floated barrel.

What we are talking about here is mindset. The first bedding job involves full preventative measures. With second and consecutive barrels it’s a let’s see game. Of course, if you wish to fully re-bed with each new barrel - that is entirely up to you. The issue here is labor. Many shooters do not like the thought of continual re-bedding.

If I had to estimate the average, based on past experience I would say that knox bedding accounts for around .2 to .4 MOA increased accuracy in rifles that are under stress (excluding finicky performance: some loads shoot well, other loads dramatically wider). But again, I am talking about actions or barrels that are actually under a degree of stress. Sometimes a barrel will shoot just fine fully free floated, even if it is placing the action under a great deal of stress loading. If we use the analogy of the baseball pitcher, the timing and consistency of when the ball leaves the pitchers mitt will affect POI and accuracy. In this sense, the goal is to get the barrel "throwing the bullet" the same way each time. Any stress loading within the action or barrel can make this difficult.

If there is a full heat treatment stress within the bore, this type of barrel channel bedding will not help. We can dampen vibrations of a lightweight barrel with channel bedding, but we cannot perform miracles. Heat treatment flaws can only be addressed via pressure point bedding. Careful load development can sometimes help address barrel stress. My own preference is to re-barrel.

Never try to re-bed a barrel channel after re-barreling. Either re-bed the entire rifle or leave the barrel channel free floated. No matter how hard I have tried during experiments, I have only once performed a job that I was entirely satisfied with. Other times, the freshly poured compound

in the barrel channel generally finds a way to leak back into existing bedding, even if it simply traps the recoil lug in place. If you wish to test mock barrel bedding after re-barreling, I suggest that a simple block of autobody filler be used to perform tests. This should be set at least a half inch forwards of the action to prevent any leaking into the action area.

With the preliminary issues of pillar bedding and barrel channel bedding addressed, we can now move on to the job of bedding.

Summary of Key Points:

- Bedding the beginning of the barrel (knox) can help alleviate action stress and dampen harmonic vibrations.
- Full free floating can be experimented with following re-barreling, before launching into rebedding.

Rifle bedding

The following information is based on the instructions that come with our MatchGrade bedding and Stabilizer compounds which I designed myself after very lengthy research and development. The bedding compound is steel reinforced along with other additives, all of which I put into the design specifically for rifle bedding. My apologies to those who have already utilized our bedding kit instructions and have now found them reprinted here. These instructions are however far more detailed than our basic printed document. Furthermore, having these instructions in book form also serves as a more permanent resource.

The instructions for our bedding compound can be used universally with other compounds. However, it is important to understand that different bedding compounds have different viscosities and physical qualities. These instructions are relevant to our pourable metal filled compound, designed not just for maximum strength, zero shrinking, and all of the usual buzz words, but also for maximum void filling qualities. In other words, it does its best to fill right angles and odd shapes.

To begin with, if you wish to bed a plastic rifle stock, you will need to first strengthen the forend as well as filling it, in order to remove the skeletal voids. If you do not fill these voids, you will end up using copious amounts of heavy compound while still trapping large amounts of air in the job. Also, if the forend is not stiffened, it will continue to flex as explained in the barrel bedding section of this book.

I designed a bulk, light weight epoxy resin specifically for filling plastic stocks which we (Steph and I) named MatchGrade Synthetic Stock Stabilizer. We use this on our own rifles, client rifles, as well as exporting it internationally for several years now. Again, this is a pourable epoxy resin for void filling.

MatchGrade Stock Stabilizer instructions

You will need:

- Stock stabilizer part A and Part B.
- Masking tape.
- Knife or long piece of wire.
- Gas cooker/Gas torch.
- Plasticine from MatchGrade bedding kit (some situations).

Mixing instructions for Stock Stabilizer

Pour part B into part A, stir well.

Cleanup

Use citrus based cleaners or brake cleaner/degreaser type sprays. Hoppe's is a good solvent for metal work.

Job planning

MatchGrade Synthetic Stock Stabilizer should always be utilized in conjunction with full bedding for optimum rifle accuracy. The job of stabilizing the stock should be done prior to bedding but can be done afterwards if necessary.

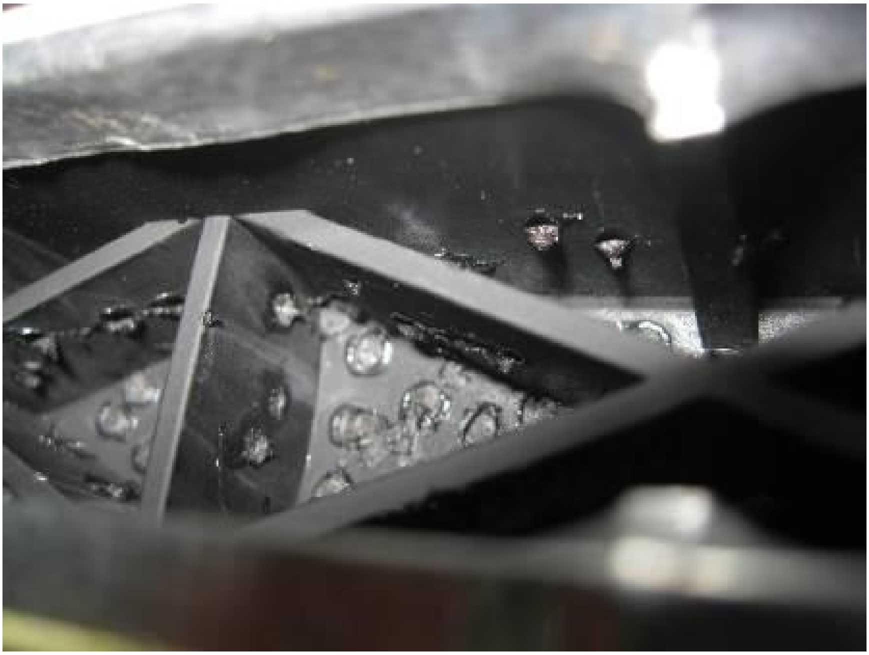
All plastic synthetic stocks feature an internal skeleton throughout the forend. The skeleton sits low in the stock so as not to interfere with the barrel. Stock stabilizer is used to fill the stock level with the top of this skeleton. The finish will be a flat surface.

Job time is generally 1 hour.

Stock preparation

Disassemble the rifle and put all small metal components into a suitable storage container. Once separated, the gunstock needs to be masked to protect it during the work process. It is best to use a layer of cling film or newspaper under the masking tape to minimize the amount of masking tape that actually contacts the stock. If a vice is to be used to hold the stock, ensure that several layers of tape are put onto the stock where the vice jaws will be in contact. Be sure to remove any oil residues from within the stock, using a degreaser (citrus based household degreasers work well)

The next step is to rough up and key into the stock, so that the compound can obtain good adhesion to the stock. On synthetic stocks it is imperative that 'mechanical locks' are created by cutting overhangs in the side walls of the stock. For best results a knife or length of wire can be heated with a gas cooker or torch and used to key into the plastic. This gives a good mechanical lock without creating lots of dust and mess. Other options for this work are either a rotary die/air grinder or a chisel- however it is still imperative that the job be finished with a hot knife and or wire as a means to burn petroleum from the stock. If using a rotary grinder, tungsten deburring heads driven at low speeds are much more effective than stones or poly rolls. The latter tend to produce too much heat, melt the plastic, and become fouled and unable to cut within less than a minute.



Burning the forend of a Sako A7 with hot wire in preparation for stabilizing. The use of a hot knife and or wire is imperative during plastic stock stabilizing and bedding operations.

Dams

If stabilizing the Howa/Hogue, you will find that it is best to plug the recoil lug recess with plasticine, thereby damming the action area of the stock and allowing for a good stabilizer fill. Failure to utilize a dam will result in a shallow stabilizer fill (to prevent overflow into the action). This will yield less than optimal performance and also compromise bedding operations. Plasticine dams can also be useful with other rifles, depending on the actual design. Common sense is all that is required.

We have also noticed that some recent Remington SPS rifle stocks have holes leading from the skeletal sidewalls of the action into the front action screw hole. We therefore suggest filling the front action screw

hole to prevent leakage, prior to filling the skeletal areas of the action. Again, use plasticine to fill the action screw hole (supplied with MatchGrade bedding kit).

Mixing and applying Stock Stabilizer compound

Simply add part B to part A and mix thoroughly, but try to avoid aggressive agitation (electric drills) which leads to air bubbling.

The mixed compound will be runny enough to simply pour into all areas that require filling. This product has an open time of over one hour (ambient temperatures will effect open time) without excess heat so there is no need to rush.

Filling the Sako A7 forend.

If there are any skeletal voids in the action area of the stock that need filling prior to bedding, fill these. But remember - do not fill the recoil lug recess!

This is the action area of the Sako A7. It has two skeletal voids behind the recoil lug which need filling prior to bedding. The Remington SPS is much the same.

Curing

Ensure the gun stock is kept absolutely level until the compound becomes hard. Due to the liquidity of the product, it will follow any tilt of the stock. Within the first 10 minutes of pouring the compound, small air bubbles may appear on the surface. These bubbles can be eliminated by popping them with a heated needle. The bubbles make no difference to stock stability or the integrity of the compound, they are simply an aesthetic issue.

Once the desired surface finish is achieved (air bubbles removed, stock cant correct), the job should be put aside and allowed to initially cure without post heat.

In cold, winter conditions below 14 degrees Celsius, post heat should be applied after approximately 7 hours. Warm hot water bottles and blankets are sufficient for this. In summer conditions, **post heat must be avoided** to prevent superheating. The job should simply be allowed to cure and harden at ambient temperatures.

Finishing the job

The filled stock needs very little attention once stabilized. Nevertheless, the rifle should be checked to see if the barrel is fully floating (not contacting the stock) if this is intended. If the job does not look as aesthetically pleasing as planned, the cured compound can be sanded and shaped to suit. That said, due to the fact that MatchGrade Synthetic Stock Stabilizer is a lightweight product and lacks the density of our metal filled bedding compound, very small air bubbles/pin holes will occur when the surface is sanded. Exposure of pinholes does not have any negative effects other than visual appearance. These small pinholes can be ignored or filled and painted over.

The Sako A7, stabilized and bedded.

Summary of Key Points:

- Use stock stabilizing as a means to reinforce plastic stocks.
- Stock stabilizing must be performed in conjunction with rifle bedding.
- Burn prep critical.

Some notes about our bedding compound

Many of you are already familiar with our bedding compound and I certainly do not want to create an infomercial here. Nevertheless, I do want to cover some of the aspects of compound design, which I believe

are important considerations when looking at bedding compounds in general.

We utilize a metal filler for both compression strength as well as density which helps force out air bubbles. Air bubbling generally occurs during mixing. In other words, we mechanically fold air into the epoxy. This air can cause structural problems while generally degrading the aesthetic appeal of the finished job. We chose a metal filler that would not react to gun metals or rust. The ratio of metal filler had to be such that the filler did not compromise the strength of the epoxy and so forth. My first attempts at creating a bedding compound were in truth quite hopeless. The compound was as hard as porcelain but brittle. I then went too far the other way as can be expected during research and development. Eventually, after many trial batches and bedding jobs, I got it right.

I have already spoken about viscosity. It took me some time to get this right. The compound went through a few changes in this regard, as we worked out what would be best for end users. For example, our first mix was very stiff which was great for newbies because it was not heavily reliant on dams to prevent seepage. But being very stiff, it could still trap air and would not mold to the shape of more complex action designs. Eventually we settled on a mix that would suit both professional users (gunsmiths) and DIY users with optimum migration properties. The compound is reliant on dams, so we provide both a high quality plasticine as well as suitable instructions for those new to bedding.

We aimed for zero shrinkage with the compound - it's pretty hard to shrink the metal filler! But you know, I think some people get too carried away, worrying about epoxy shrinkage. I have seen a few folk go into these silly endless intellectual debates about shrinkage, and I think to myself: What happens when you add your protective coating to the

metal work after the job is done? A smear of grease and your .00001 tolerance is gone. Some people just go too far, huh?

Our hardener is somewhat mix ration critical. We used to supply the compound in bulk but found that both smiths and DIY users were often a bit lax about mix ratios. I once saw a smith literally pour a splash of hardener into the epoxy resin, then state: “That looks about right”. Most epoxies are sensitive to mix ratio, and those that aren’t are sometimes of the type that do not set glass hard and instead retain a softer, plastic like hardness after curing. Our ultimate fix was to put the kits into pre-packed mixes. We could then use an oversize container which would work as a mixing bowl, its width allowing folded air to escape across a wide surface area.

As you can see, there was a lot of time put into the design. I had to bed and test shoot a lot of rifles over and over again to study results. The compound had to be user friendly, it had to be strong, it had to have a nice finish, it had to enable the rifles to reach its full accuracy potential, it had to last long term, and it had to prevent oils from seeping into it or under it, as I have seen some brands do. It was very time consuming. Occasionally, I will get an email in which the customer asks what makes our compound better than others. I will then go into the usual blurb about metal fillers, air release agents, accuracy, long term strength, and ongoing customer support - all the usual marketing speak. But to be honest, sometimes I just don’t know how to reply. How do you convey the hours and hours of research you put into something like this?

We use Kiwi liquid boot polish in our kits as a release agent. There are various brands of liquid boot polish, and during research and development we found that not all are equal and some were utterly hopeless (Anyone got a chisel?) as release agents. To be fair, none of these products were ever developed to be release agents. The brand we chose is a mixture of producing fine coverage (which can also be built up

in layers) and being an excellent mold release. We also experimented with latex mold release agents, but oddly these promote air bubbling within the job, depending on climate. Furthermore, the latex would at times peel during job handling. But worst of all, it would bead on highly polished steels rather than form a fine layer. A basic wax based product is the go, and our current agent has proven to be the most reliable. Its black color can be used to observe coverage, and although it can be annoying to remove it is the best product we have found for the purposes of bedding. This release agent also makes for a good base layer protective coating on matte blued or parkerized rifles for long term corrosion protection.

The plasticine we use is a very high quality artist grade. This plasticine is very dense, so that after molding and forming dams, it will not slump in the barrel channel. Heat can be used to soften the plasticine for molding the barrel channel dam, but once the final shape is achieved and packed in placed the dam will not collapse or slump during post heat. It doesn't get any better than this.

I got caught out with poor quality plasticine early on during research, using a cheap plasticine which melted during post heat and mixed in with the bedding compound - talk about an ugly bedding job. I have seen folk plagiarize our bedding instructions in gun magazine articles, using other brands of bedding compound while using the same low quality plasticine that caught me out during early research. Sometimes it can be a little thing that makes all the difference - and this is one of those times. I have also used modelling clay. I am not too great a fan of this because it adds moisture to the job, if used when still wet and moldable. I also do not like to bed onto clay dams, if the clay is left to dry due to cracking; but this is more of a personal preference. Nevertheless, those folk who do not intend to use our plasticine or a high grade equivalent would be well advised to use artist grade

modelling clay (formed and left to dry), rather than cheap plasticine or play dough.

MatchGrade Bedding Instructions

You will need:

- MatchGrade Bedding Compound part A and B.
- MatchGrade Release Agent.
- Masking tape.
- Insulation tape.
- Newspaper and cardboard.
- Craft knife.
- Dremel, or end grinder, or chisels.
- Plasticine (supplied with MatchGrade kit).
- A drinking straw.
- Degreaser (household citrus based cleaner will suffice if necessary).
- Headless bolts (bolt stock), either ¼” UNF or M6, depending on rifle brand.
- Cleanup rags.
- Sand paper, 120gr, 180gr, 240gr and 320gr.
- Drill and drill bits, either M7 or 9/32 bits.
- Bungee cords (strips of tire inner tube will suffice).
- Old bits of foam.

Other useful kit includes:

- Powdered graphite (extremely useful as an additional release agent).
- Aluminum tape.

- Bone from roast, fashioned into chisel. This is non marring for scraping stuck compound off metal work (extremely useful).
- Carbon fiber or fiberglass (or pig hair!) for use on Hogue stocks and difficult fiddly tang designs.
- Files, needle files and chisels of varying sizes.
- Sharpening stone for chisels and craft knives.

Mixing instructions for MatchGrade Bedding Compound

Pour part B into part A, mix well.

Cleanup

Use citrus based cleaners or brake cleaner/degreaser type sprays. Hoppe's is a good solvent for metal work. De-Solv-It brand solvent is at this time of writing, perhaps the best cleanup product ever made for bedding operations.

Mindset

One of the major aspects of bedding, which I have neglected in our kit instructions, is attitude or mindset. It takes around 12 - 16 hours to complete a bedding job. As you get better, you tend to pay more attention to detail, rather than cutting down job time.

You have by now heard me talk about 'chop shops' several times. Sometimes these guys will do a bedding job within a couple of hours - like the mock bedding we did earlier. If I take old Boz and Sarge for a walk down the road after a big dinner, both dogs can achieve something that looks similar in under 5 minutes. A good bedding job takes time!

You may be very nervous about bedding, and you need to know that this is quite normal and quite fine. But it can also be very detrimental to your concentration and motor skills, if left unchecked. The best way for

me to ease your mind is to say this: At the end of the day, it's just a piece of metal and some wood (or plastic or fiberglass). We are not dealing with life threatening surgery on a loved one. If this bedding job all turns to custard, who cares. On the grand scale of your life events, this job is utterly meaningless.

Ok, so it's just a piece of metal and who cares. That is the start. The next thing I want you to say to yourself is that you are now going to do your very best with this job. My point is, while we need to put the job into perspective for your nerves, we do not then want to be so casual, as to contemplate the services of my Labrador or Vizsla. It's the old violin string theory: If the violin is strung too tight, it goes out of tune, if it's too loose, it goes out of tune - and you cannot perform your Death Metal concerto. Just like the violin, we need to be somewhere in the middle.

I have seen folk go both ways, and that's just reading the instructions without even beginning the work. Some folk are so casual about bedding that they gloss over our instructions without understanding them and then make very basic mistakes. That I cannot help, other than to say: You need to lift your game. Some folk become so anxious that the instructions suddenly appear as an alien language, and again very little is taken on board.

I need you to get this through your head - you may very well stuff up your bedding job. I have made so many stuff ups over the years, especially when getting my head around new action designs. If you think that I gained expertise via success, you are dreaming. Expertise and success are born out of the overcoming of adversity and failure. People who claim to get everything right all of the time are either not challenging themselves or are liars and in many cases are complete knobs and not worth knowing anyway. You need to face the fact that

you might stuff this up and have to start over - and keep starting over until you get it right.

Some folk treat bedding as a one shot deal, as though if the job goes south, the rifle will be permanently destroyed. Then, when the worst case does occur, they will do such things as spray paint the bedding job to hide it and employ all sorts of convoluted quick fixes, while trying to both hide and overcome their disappointment. Tell yourself: Bollocks to that - if I stuff this up, I can handle it. I will do the job again and again until I get it right. In doing so, you will not only rectify your current job, but you will also develop a well-practiced understanding of the bedding process in general.

DIY operators can derive great pleasure from rifle bedding. A good gunsmith will find the process annoying because it is very time consuming and monotonous, especially if he has to rework the job and loses 30 hours from start, to rework, to finish. Gunsmiths can at times get nervous about bedding, not due to a lack of skill or general self-confidence but due to potential time lost and financial concerns, if mistakes do occur. If you are a gunsmith, the same rules apply: We have to keep things in perspective - it’s not the life of a loved one!

As a DIY operator with no time constraints you can enjoy the process immensely, so make the most of it - be happy in your work.

Remember, mindset is a key factor. Be very patient and try to work towards a relaxed state of mind. Set high expectations of yourself but also welcome failure and be kind to yourself if this occurs. I suggest that you fully read through the instructions first, then re-read the instructions in steps, as you set about your bedding job. You will need to be in the right frame of mind (no distractions etc.) to read the entire instructions, especially those given here because I have elaborated on certain subjects.

1. Stock preparation

Steph and I always start with stock preparation, and then proceed to action preparation. The reason for this is that you will need to perform several trial fits with the action. If you prep the action first, then bump the action several times during trial fits, the action prep will be ruined. So work on one first - then the other. Basically breaking the pre-bedding work into two phases.

My very first step is to wrap the muzzle of the barrel in masking tape for protection. You will be handling the barrel in a different manner to that which you are used to, and it is so easy to bump the muzzle against a vice or other workshop (and home) equipment. Do not degrease the barrel when you do this, leave its protective coatings in place and simply bind the muzzle as best as you can. Make sure the tape is thick; you can use a small piece of cardboard to further bolster protection. Whatever you do, make sure the muzzle is well protected. This is not the same as protecting the muzzle using tape when hunting, due to the risk of damage from metal to metal contact.

Next, draw a pencil line on the action and barrel, along the intersection of the metal work and top line of the stock. This will establish the correct height the action needs to sit at during bedding.

Remove the scope and strip the rifle down into basic components. Put all of the smaller metal parts (floor plate, bolts etc.) into a plastic container. Remove the trigger unit from the rifle action to prevent compound from entering the unit. Note: the trigger housing of Ruger rifles cannot be removed and must be worked around (cover with plasticine).

For beginners (or for experienced operators working on new rifle designs) it pays to take photos of the internal gun stock before starting any prep work. This will help later when grinding out the cured

compound, you can refer to the photos to see what the stock internals should look like during grinding.

You will need to consider whether you wish to adopt front and rear (F&R) bedding versus full length (FL) bedding. With F&R bedding, there will be no bedding in the area of the magazine well (midsection). With FL bedding, the entire action is bedded. Generally, I find that most beginners find F&R bedding the easiest unless bedding the M700 or Tikka T3 actions.

A full length bedding job is certainly very sound and can fully stabilize a wooden rifle stock, preventing the wood from warping between the tang and recoil lug which could potentially place stress on the action. FL bedding can also help eliminate stock flexing in plastic rifle stock designs. But in all honesty, I have never seen any major differences in accuracy between the two methods, as long as prep methods and bedding techniques are sound. Provided the stock is sound (sealed if wooden), there are no high spots in the mid action area when F&R bedding, and care is taken with bungee tension, the accuracy potential is generally the same with both methods.

My advice is that if you are nervous about bedding, adopt F&R bedding unless you are bedding an M700 or Tikka. If you are an experienced workman, adopt FL bedding but be wary of some action and/or stock designs (such as the Ruger M77) which could get you into trouble. If bedding the Hogue stock, I recommend front and rear bedding. Most folk will also find F&R bedding an easier option when bedding Mauser rifles. The Ruger M77 needs to be F&R bedded due to the non-removable trigger unit. The Remington M700 and Tikka T3 are generally straight forwards to bed, whether utilizing F&R or FL bedding. But as suggested, if a Hogue stock is employed, F&R bedding is recommended due to the more difficult nature of the rubber molding.

Once you have decided which bedding method you wish to adopt, you can determine where you need to remove stock material and how you will adopt plasticine dams. We will address both of these issues as we continue forwards.

The gun stock now needs to be masked to protect it during the work process. I recommend a mixture of cardboard and masking tape. The cardboard is cut into strips and laid against the sides and underside of the stock and taped in place with masking tape. This will help protect the stock during handling. The butt stock can be wrapped in newspaper or bubble wrap, taped in place at the pistol grip.

If you are still learning how to work with hand or power tools, the top line of the stock should also be taped with either masking tape or electrical tape to protect it from Dremel/tool slippage. After you have finished your inletting, you can replace this with a fresh piece of electrical tape.

The next step is to rough up and key into the stock, so that the compound has both, a good adhesion to the stock as well as a good buildup of compound rather than a fine but weak shim.

When preparing the stock, leave a sliver of parent material at the tang unground - to be used as a height reference. You will use plasticine in the barrel channel to set the height of the bedding at the front. You may however wish to use pillars as a height reference.

Use either a rotary burr (Dremel/air tools/die grinder) or chisel to remove stock material in the area of the action and tang. We use a rather expensive Metabo variable speed end grinder with both 6 mm and ¼ inch drives. Many of you will prefer to work with cheaper Dremel type units. The Chinese units are quite adequate for DIY work. The Dremel brand is top notch kit for DIY operators. Air grinders can also be very useful and can utilize 6 mm and ¼ inch tool heads. Our end grinder

is much larger than a Dremel with more power than an air grinder. This grinder removes material very quickly which is ideal for commercial purposes.

If you are adopting an F&R bedding job, there is no need to remove stock material within the magazine well area. You will need to remove material from the tang, then remove material from the front of the magazine well forwards. If you are adopting FL bedding, you will need to remove stock material along the sides of the magazine well.

Some of the barrel channel will have to be roughed up, but a decision needs to be made on just how far into the barrel channel will be the optimum distance for bedding.

To decide the optimum distance for barrel bedding:

- For target weight barrels put the bolt into the rifle action (scope attached) and determine the balance point. Hold the action in one hand and hold the barrel with the crooked index finger of the other hand. Slide the barrel along the index finger to determine its balance point. Once established mark this area of the barrel with masking tape and transfer this measurement to the stock.
- For sporting barrels that feature a parallel area at the beginning of the barrel, bed to the end of the parallel.
- On sporting barrels that lack a parallel, bed for a distance of (approximately) 1”.
- If bedding full wood military rifles (e.g. SMLE), it can pay to bed several inches into the barrel channel. This can be ground back later if need be, or an additional bedding pad can be placed at the first barrel band later if need be.

Please note that with very heavy barreled rifles, the balance point can be halfway down the barrel channel which is simply too far to bed,

trapping too much of the barrel and using far too much compound. Furthermore, the stock itself may not be conducive to bedding to such a length. In this case I suggest bedding roughly 2.5” to 3” into the barrel channel. This may make the balance point exercise seem pointless however I believe it is still something worth understanding and if for example you bring your finger back to the 2.5 or 3” mark, you can gauge by hand just how much stress will be loaded on the action screws after bedding.

Masking taped gun stock; this rifle will be full length bedded, so we have not created a drain at the rear of the magazine well.

On wooden gun stocks the user has two factors to consider. If the bedding job is to be absolutely discreet, great care will need to be taken during the removal of wood along the top edges of the action and barrel channel. Care must also be taken with brittle woods which chip easily during shaping. Unfortunately, the more discreet the job is to be, the weaker the product will be at the top edges due to the thinness of

compound in these areas. My own preference is for a tough, field practical job that will also resist moisture associated stock warping.

Generally I recommend a bedding thickness of 1.5 mm to 2 mm or 60 to 80 thou. In other words, this is the inlet required during stock preparation. If we employ less than this, there is a risk of compromising the strength of the bedding. If we go much thicker than this, we run the risk of using copious amounts of bedding compound (possibly running out of compound!), trapping large volumes of air within the job, and also causing suck backs as a result of slumping. That said, it is typical to end up with a more generous layer of bedding compound in the barrel channel. Nevertheless, the complementary shape of the barrel and short distance of the barrel channel bedding generally ensure that this area will be trouble free.

Ultimately we need to avoid both, skim bedding jobs and black hole bedding jobs which absorb all matter within a half mile of the rifle.

With Synthetic stocks including the Hogue, it is absolutely imperative to key into the sidewalls utilizing heat. After inletting the stock, burn the bottom and side walls of the stock with a hot knife/hot wire. Use either a gas cooker or blow torch to heat tools. This will give the compound both a mechanical lock and full adhesion where oils have been burnt out of the plastic. Furthermore, the top edges of the Hogue stock should show a good gap of again 1.5 to 2 mm (60 to 80 thou) for optimum strength of bedding. Do not attempt to bring the top edge of the Hogue to a more subtle fine line of bedding compound.

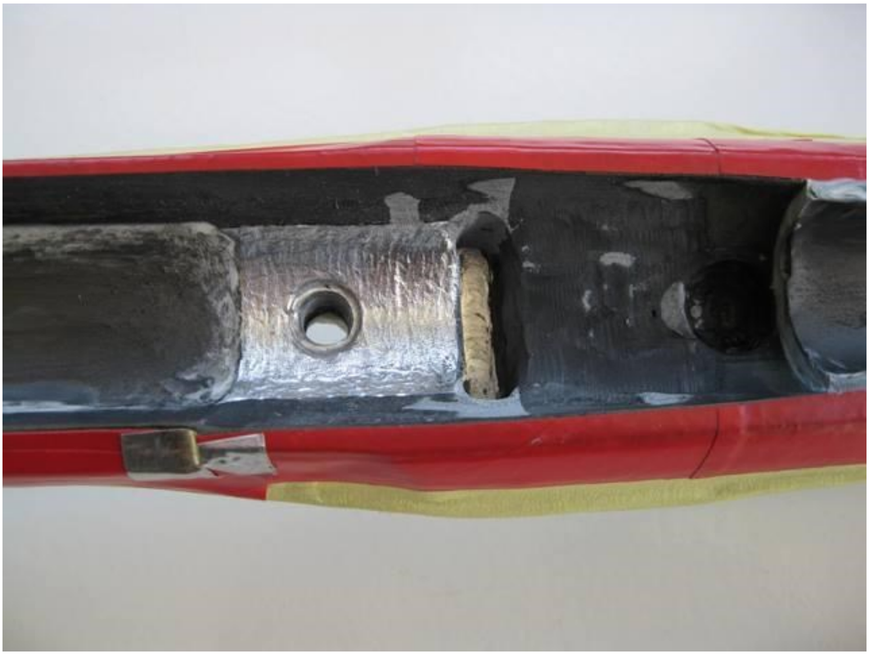
Check for clearance between the stock side wall and action metal. On wood stocks, a tighter fit is more discreet but lacks strength at the top edges and is not actually a great deal more aesthetically pleasing than a 'bedding border'.

Bedding border on wood blue Howa/Weatherby.

The Hogue stock is the most difficult of all synthetic stocks to bed. The lower halves of the stock sidewalls are made of plastic while the upper section consists of soft rubber. The rubber needs to be heavily keyed; and for those who want the ultimate in strength, small patches of chopped carbon fiber or fiberglass should be inserted against the side wall when the bedding compound is applied.

When bedding stocks with floating recoil lugs (e.g. Tikka T3), you will need to make sure that plenty of stock material is removed from the lug inlet. If you do not make this area a loose fit, you might bump the lug out of alignment as you place the action and lug into the bedding mortise. I would suggest roughly 2 mm or 80 thou as the ideal clearance for the lug (front, rear, sides, and bottom).

Once the stock is inletted, you will need to apply electrical tape to the top line of the stock. It is important that you degrease the top line of the stock first to ensure the electrical tape has maximum adhesion. The tape should come within .2 mm or 10 thou of the inner stock wall. You may also wish to use small strips of aluminum tape in areas where the stock changes height, such as each end of the ejection port. This can help prevent the electrical tape from lifting.

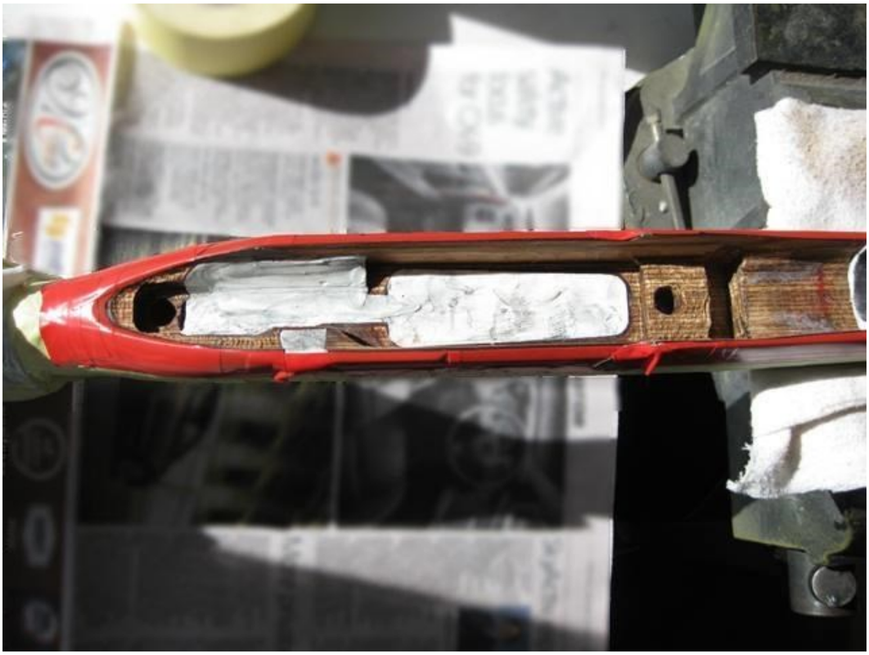


Steph has prepped the above M700 Sendero rifle stock. The electrical tape comes to within .2 mm/10 thou of the stock inlet. She has also placed aluminum tape at the point where the stock changes height at the ejection port. Following her tape work, she has fitted the plasticine dams.

At this point we need to fit plasticine dams in the stock to prevent the bedding compound migrating away from where it is needed. The front plasticine dam in the barrel channel can be used to set the height that the action will sit during bedding. Most rifle actions are height critical so it is important to get the height right, especially if a lot of stock material was removed during preparation.

Fitting the dams (Howa/Hogue). I am midway through forming the dams. Following this, the barreled action is checked for fit. On this rifle, I am performing a front and rear bedding job (no bedding through the mag well. You can see the gap in the mag well where I will allow the compound to seep down. It pays to cleanup this seepage immediately after setting the action into the mortise.

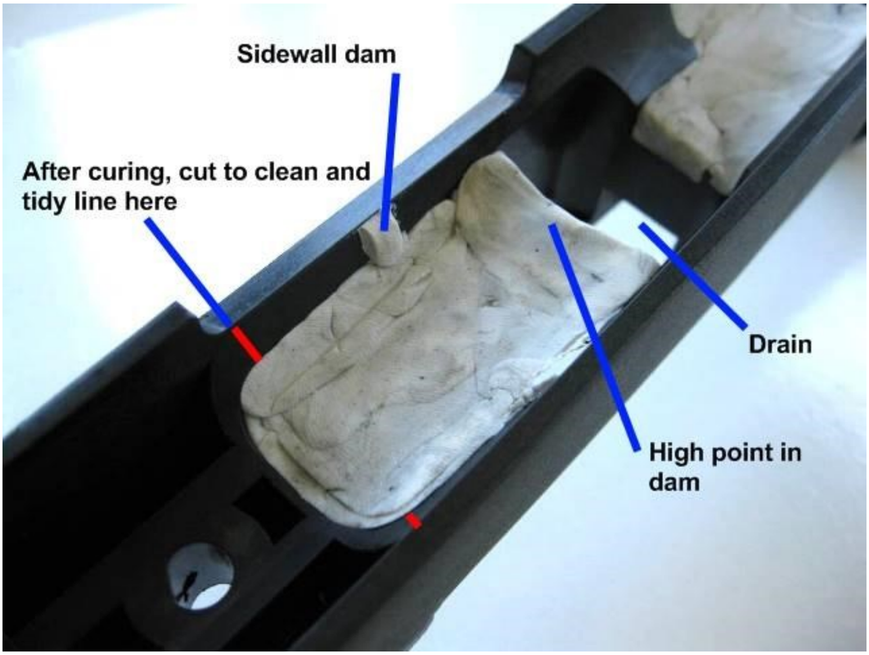
This Howa/Weatherby wooden stock is being prepared for full length bedding. I have also glued pillars in place. Note that I have also made masking tape skirts along the side of the action to aid cleanup. I'll pull and throw these skirts away after the action is put into the mortise.



Winchester M70 stock preparation.

Fit the dams and shape the barrel dam to a tidy concentric mold that ensures the headless screws will be centrally aligned to the action screw holes within the stock. Please note: **The height of the barrel dam will determine how high the action sits. The front dam is your height reference point** (By leaving a sliver of stock material unground at the tang, you will have a rear height reference point).

If working with long heavy barreled rifles (free floated), it can pay to make a small plasticine mold at the forend tip to help take the weight of the barrel and alleviate any potential stress. However, be careful to ensure that the tip mold is complementary to the height of the barrel channel dam. If the barrel is not currently free floated and utilizes pressure point pads, these pads can be left in place until the bedding is finished - free floating the barrel as a final job.



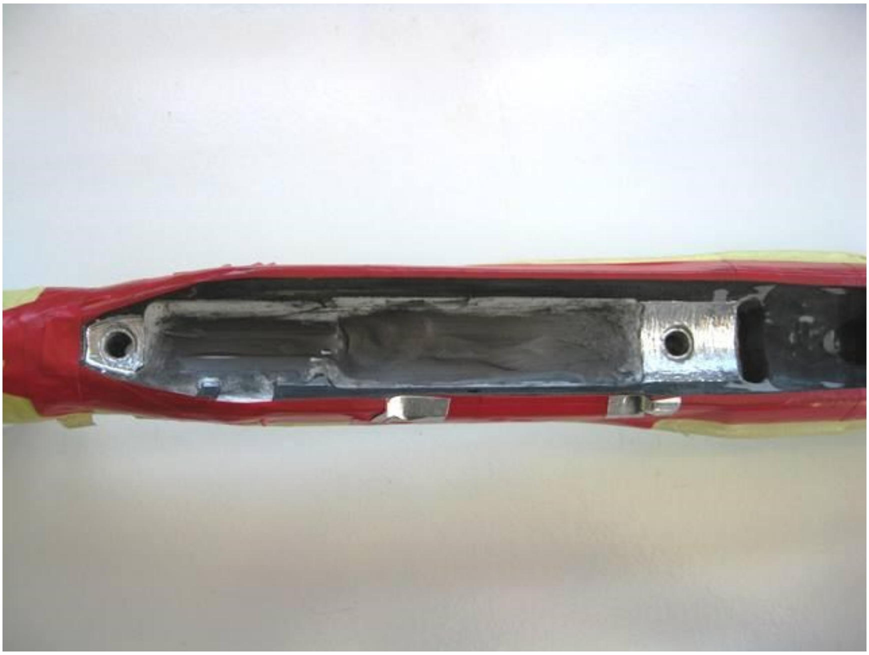
Close up of plasticine application for front and rear bedding. After the bedding compound has cured, the compound can be cut to a clean and tidy line at the front of the magazine well. Please note that this example SPS stock has not been prepped and needs to be stabilized first (see skeletal voids).

If F&R bedding, you will need to create a drain hole in the magazine well plasticine dam, as shown in the labelled picture. You will also need to create a high point at the rear of the plasticine dam to prevent seepage, as well as small sidewall dams. Once the action is set down into the mortise, it is imperative that all mag well seepage is cleaned up by reaching in from underneath and cleaning with a solvent and tissue or cotton buds.

Full view of M700 stock (example) with tang dam.

If performing a full length bedding job, the entire mag well will need to be dammed.

Once you have your dams in place, you will need to coat the plasticine with a Lee case sizing wax or powdered graphite to prevent the dam from lifting out of the stock during trial fittings which we will perform after preparing the action. Our barrel channel dam is probably not quite right yet, but again, we will correct this later.



Full view of Remington M700 Sendero stock being prepped for full length bedding. The plasticine has been dusted with graphite to prevent adhesion to the action during trial fitting. Skirts and temporary foam dams yet to be fitted.

You can now perform a basic trial fit to check the height of your action against the pencil line before it is removed as part of the degreasing. You will need to wipe any surplus oils or protective coatings from the action while being careful not to remove the pencil line. The next step is to fit headless screws to the action to act as guide rods for optimum alignment. Japanese and European rifles normally utilize metric M6 bolts. On American rifles, use standard ¼ inch UNF headless bolts. Use 10-32 for the Ruger M77 tang screw. I tend to buy meter long lengths of thread stock in 6 mm (M6), ¼ inch UNF, and 10-32 which I cut down to size for commercial operations. You may prefer to simply find suitable bolts from an engineer's supply store, then cut the heads off. You will

need to lightly tape the thread so that it does not get bound in the compound, leaving only 6 mm or ¼ inch of the thread exposed which you will screw into the action.

Please note, you will also come across proprietary threads for which you cannot obtain a simple mock replacement - Winchester being a classic example. In such cases you will find that ¼" UNF, for example, is close enough that the screw can be wound a short way into the action and obtain proper alignment. You do not need to crank these screws up tight, so there is no risk of action thread damage. Also, please utilize this method rather than assembling the rifle with its floor plate and action screws during the bedding process. Assembling the rifle can place strain on the action during bedding and also lock the floor plate in place if any compound seepage occurs.

With the headless screws in place, you can perform your first round of trial fitting. Use this time to check the action height and reshape the front dam as needed. Trim the face of the barrel channel dam with a craft knife to form a clean aesthetically pleasing edge for your bedding. Check for pinch points within the stock, making sure that the action passes easily into and out of the inletted stock.

At this stage you can also make small plasticine balls of about 3 mm/120 thou diameter and place these in the stock where the action is to sit. As you trial fit the action, these will be squashed down and will give you some idea of how thick the layer of bedding compound will be. But remember to remove these test balls prior to pouring the compound.

Once you are happy with the preliminary fit, you can then move onto action preparation.

Summary of Key Points:

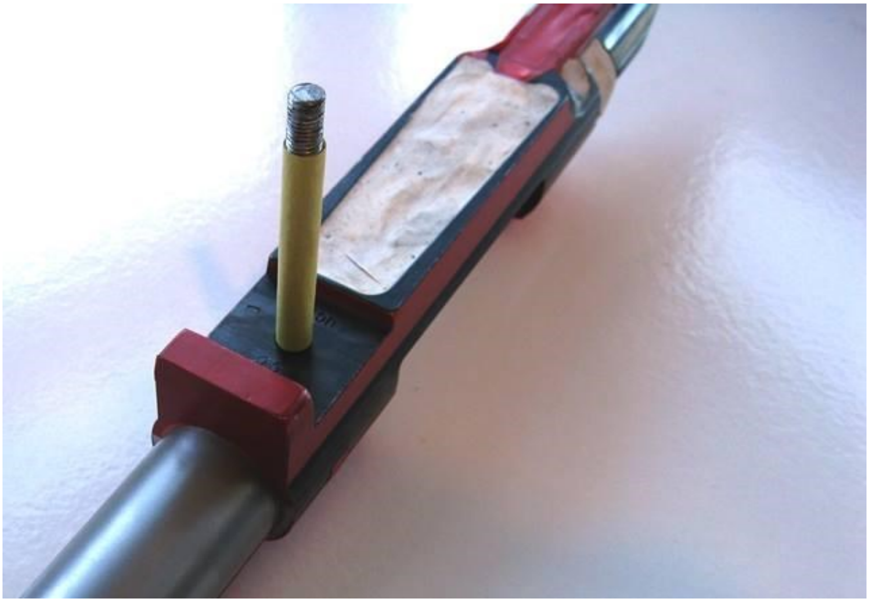
- Pencil line.
- Photos.
- Tag and bag all small parts.
- Decide if F&R or FL bedding.
- Determine height reference point at tang.
- Grind/inlet stock to 1.5 to 2 mm or 60 to 80 thou.
- Key plastic stocks with hot knife.
- Double check lug inlet for floating lug designs.
- Electrical tape top line.
- Fit dams in place and graphite/wax dams.
- Trial fit action.

2. Barreled action preparation

The first step of action preparation is to degrease the action using brake cleaner or another solvent, followed by meths. This will allow the electrical tape (called insulation tape in NZ) to adhere to the metal work.

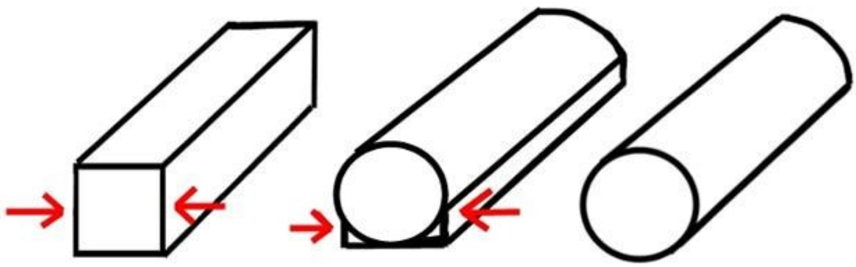
While the goal of bedding is to create a mirror image of the barreled action, it is imperative that certain areas of the rifle action are relieved (covered in my first book). This prevents the action from becoming pinched or ‘hung up’ in the bedding. If the action does become pinched, random harmonic vibrations will totally destroy accuracy.

The areas that need relieving are the front, sides and bottom of the recoil lug. Also the rear most vertical face of the tang and any parallel wall metal on the action. These areas should be relieved with insulation tape or masking tape. Insulation tape is preferable as it does not bind with the compound and makes breaking the action out of the stock easier. It also pays to utilize a bright colored electrical tape (yellow or red) as this tends to be easier to observe for removal during later operations. I use a razor sharp craft knife to cut tape; and if I need to lay the tape down and cut out a shape, such as the round shape where the M700 lug meets the action, I stick the tape to an ice-cream container lid, then cut out my shape (I cut around a film canister as a template), then peel the tape off the ice-cream container lid and apply it to the metal work.



Typical recoil lug preparation. The front, sides and bottom of the lug are tape relieved. In this instance, the rifle is a Winchester M70 which also has its parallel side walls relieved.

Some rifles have an essentially square action. If the side walls of these actions are relieved with insulation tape or masking tape, the action will be a sloppy fit later on. Instead, the side walls should be given a heavy coating of release agent.



Above are the three basic types of rifle action. The red arrows show the parallel walls that must be treated with due consideration. The square shape on the left depicts the shape of the Sako action. The middle shape depicts both the Howa and Winchester M70 actions, while on the right is the Remington M700 action. This last action is the easiest to obtain accuracy with, as it does not have any parallel side wall metal.

From time to time I am asked about the possibility of bedding the underside of large recoil lugs. If you have a rifle action design which features a very large surface area under the recoil lug (e.g. older Sako rifles), it is possible to bed the underside of the lug without tape relief. The trouble is - you must ensure that the bottom corners and edges of the lug are relieved and/or chamfered (either before or after). One of the reasons why I teach folk to tape relief is based on the long standing principle that invariably, people will accidentally scrape the bedding when fitting the action to the finished (bedded) stock during routine maintenance. These crumbs, along with any trapped protective coatings, can jack the action up off its bedding. The smaller the lug, the

more difficult it is to fit the action into the stock, and the greater the need for relief under the lug.

I recommend that the underside of the lug remains relieved, maximizing its potential to return to battery. If you are pillar bedding a Sako or Howa, this will mean that your front pillar will be left floating a touch. Nevertheless, the pillar and bedding will, when combined, prevent stock compression. The traditional Sako rifles also featured a cross bolt which also minimizes the chance of stock compression.

Some rifle designs have a huge recoil lug, particularly the current European switch barrel designs which I hope you are all avoiding. In this instance, the entire action is split like the letter C. The cross bolt (or bolts) then go through the recoil lug and draw the C together which is essentially a C clamp design. The lugs of these rifles are so large that you will have no choice but to bed the underside of the lug. Again, make sure that the sides and front, plus the bottom edges and corners of the lug are well relieved in order to avoid scraping the bedding and jacking up the action. You can double do this job by filing off all sharp edges of the lug - after bedding.

Nightmare on bedding street. A C-Clamp style switch barrel action, split nearly completely in half save a quarter inch near the mag well inlet. The lug on this rifle has to be bedded with a piece of electrical tape running down the middle to hide/relieve the split, along with tape on the sides and front. We then have to hope that the lug retains its exact shape during switch barrel operations.

Howa wood/blue rifle being prepared for bedding. Preparation is much the same as for the Winchester M70 and older Sako rifles. Electrical tape is used for relieving, plasticine is used to plug the mag well (this rifle was full length bedded). The black release agent has been applied to the action and can be seen on the electrical tape.

Howa action side view.

On the above Sako, I have used electrical tape to block the mag well rather than plasticine.

Ruger action during prep. Notice how the trigger cannot be removed. Plasticine can be used to block the trigger unit along with release agent. Note also how I have not employed a headless screw at the front due to its angle. I will instead use the front dam to precisely locate the action.

Above: A Tikka T3 ready for full length bedding, the ali lug is wedged in place, metal to metal contact at the front face only. Use electrical tape to relieve the top (bottom as seen here) and rear face of the lug. Use two pot 5 minute epoxy to lock the lug in place - this requires great care. Make sure no 5 minute epoxy seeps onto the front face of the lug.

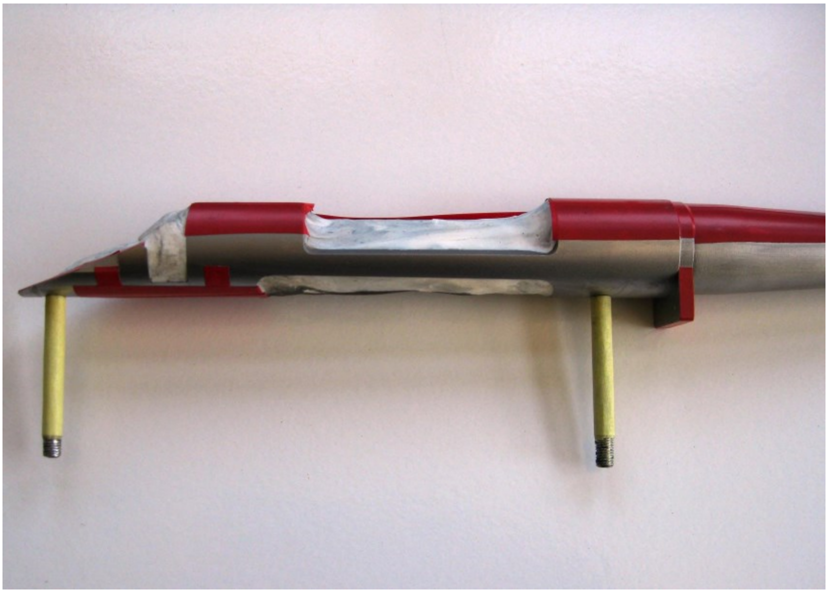
The Tikka T3, Sako A7 and Savage Axis have a floating aluminum recoil lug which needs special attention during bedding. The front face of the recoil lug (facing the forend) is the only surface that should contact the action, other faces must be relieved. This is not a typo - the front face of the lug touches the action, even though this may seem a contradiction to standard recoil lug relief where the front of the lug is tape relieved. You can verify this by observing the recoil mechanics.

To ensure that the fit of the floating lug is correct, the top of the lug should be masked off and the rear of the lug should be masked off,

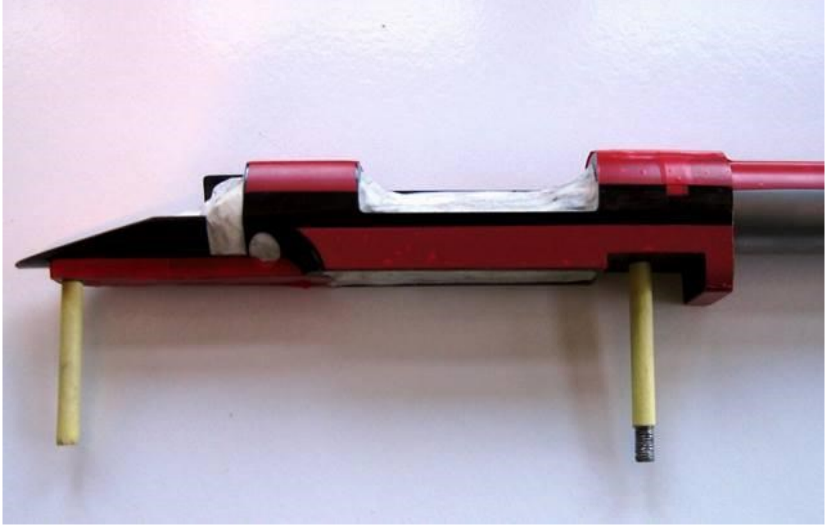
trimming the insulation tape to suit. Following this, the lug needs to be glued to the action, being careful to make sure no glue seeps onto the front face. Use a two pot 5 minute epoxy to secure the lug to the action. Once the bedding job is complete, the fine glue bond will break during removal of the action from the stock, leaving the lug in the stock where it needs to be.

Once the critical relief areas of your action have been taped, it pays to tape up all exposed metal on the top side of the rifle action (above the bedding) including where the scope bases are mounted and the top side of the tang. Tape over any engraving (serial numbers etc.). Make sure all pin holes, slots, and gas escape ports are taped off, using small squares of tape.

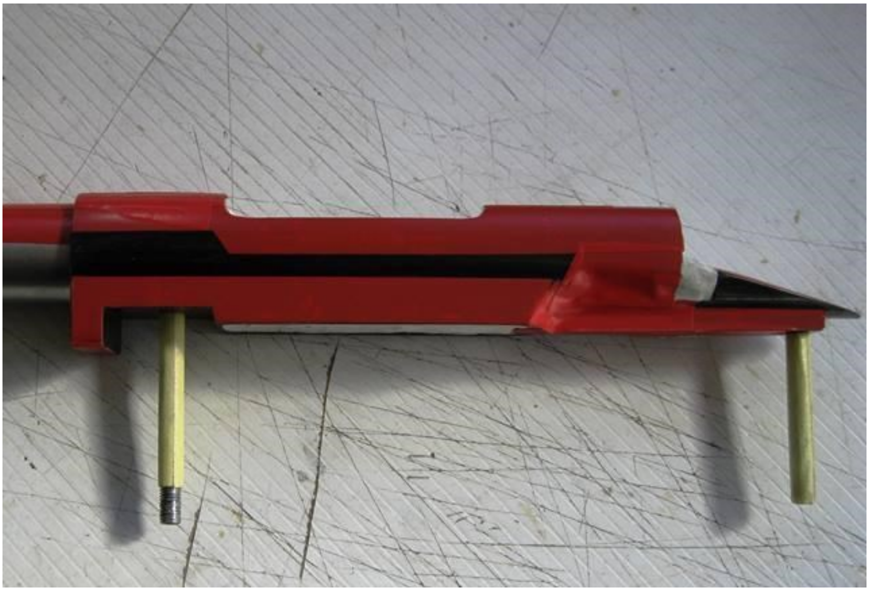
If you are FL bedding your rifle, you will need to fill the magazine inlet of the action with plasticine. It also pays to fill the bolt handle cut out with plasticine. If you are doing a F&R bedding job, you can use masking or electrical tape to block off the magazine inlet.



Remington M700 prepped for bedding. Magazine inlet and bolt handle cut out plugged with plasticine.



Winchester M70 action preparation (FL bedding).



Winchester M70, left view. It may appear as though a good deal of the action is taped off, however the flats and rounds offer plenty of contact area. The result is a super slick fit.

If you have not already done so, the headless bolts should now be masked to a thickness that allows them to **easily pass through** the holes in the stock. It is very important that you get this right. If the taped bolts are a close fit, the bolts will bind in the holes in the stock, as compound seeps into the holes. This will prevent you from setting the action down into the mortise! If there is too much of a gap, the compound will leak out through the holes. About a .5 mm/20 thou gap is good (a bit of wriggle room). Make sure that the taping is neat where the bolts fit into the rifle action, not bunched up as it meets the action.

It is important to check that when the bolts are screwed into the action, the masking tape on the bolts is flush with the action leaving no room for the bedding compound to key into the bolt threads (see pictures). You will also need some means to unscrew the bolts at the end of the

job. Cutting slots in the top of the bolts so that a screw driver can be applied later is very useful. Button head hex bolts can also be ground down to suit. We simply use a good set of vice grips (or hefty polygrips) to grip the threads and unwind the headless bolts.

We need to make a note here regarding the Ruger M77 with its angled front screw. I tend to avoid using a headless screw on the front end of this design, and instead I use the barrel channel dam to carefully align the action screw hole with the hole in the rifle stock. Once I am happy, I blank off the front action screw hole altogether. Ruger bedding basically involves front and rear bedding with a “blob” in the middle for those who are keen. This is discussed further ahead for those interested.

If you are bedding a traditional Savage rifle, you will not be able to bed the tang and will have to start your bedding just forwards of the trigger well. If you are bedding a Savage Axis, you will need to leave the trigger in place (remove the safety lever) and bed back to the aluminum block through which the rear action screw passes. The front and sides of the aluminum block should be tape relieved, the rest of the trigger should be tape relieved or plugged and coated with plasticine. I also suggest that the barrel nut found on Savage rifles is taped for relief with electrical tape. Set your barrel channel plasticine dam about 1” forwards (further for heavy barrels) of the barrel nut.

Summary of Key Points:

- Degrease metal work.
- Apply electrical tape to critical relief areas.
- Apply electrical tape to all other minor holes, slots, top side of action, tang, and barrel.

- Apply plasticine to magazine well or use tape, depending on whether F&R or FL bedding.
- Apply plasticine to bolt handle cut out (FL bedding).
- Keep craft knife very sharp, so that electrical tape is cut neatly and does not have frayed edges (keep wet stone handy).

3. Stock preparation second phase

We can now finalize the stock preparation by performing final trial fits with the tape prepped rifle action. Again, check for fit and observe the action to make sure that no tape has been marred. If there is any tape marring, the stock needs some final inletting work.

Once you are entirely happy with the fit, it is time to degrease the stock. I prefer brake cleaner for this task, as it evaporates so quickly. When degreasing use a cotton bud or towelette to clean the stock internals. This will help ensure that any smeared plasticine and its oily residues along with any graphite are completely removed from the stock. This is extremely important, especially with aluminum chassis rifles, as oily residues can easily prevent bedding compound adhesion at the tang which is generally of a small cross sectional area.

Once the stock is thoroughly degreased, I like to fit masking tape in a wide skirt like fashion, set in such a way that I can pull these away easily by hand. The skirts will save compound dribbling down the outer stock walls, making the cleanup a much simpler process.

I also like to fit a secondary foam dam over the plasticine dam in the barrel channel. You may also wish to use another foam secondary dam located in the mag well if you are performing an F&R bedding job. These foam dams will be pulled out at the last moment.

Finally, and this is very important for those new to bedding, take a drinking straw and cut two pieces of around 2” in length. These will be used for two purposes: The first is to act as locator guides because the action screw holes cannot be seen once the compound is poured; the second is to act as plugs to stop the compound from running out of the action screw holes in the stock prior to setting the action into the mortise. You will find that most straws are too thin for this task and need to be beefed up to fit. I suggest that you wrap the straws with tape. Apply enough masking tape around each piece of straw for it to sit gently in the screw/pillar holes. The fit needs to be loose enough to ensure the straws can easily be pushed through the stock by the headless guide bolts when the action is put into the mortise. You can then simply pull out the straws from underneath, as the action is coming down. It pays to tape the top of the straws to stop the headless screws entering the straws and becoming jammed. I cannot emphasize enough how important it is that the taped straws (it could even be dowels if you prefer) are of the right fit. The straws should only just sit in place and be able to be pushed through the stock and drop out onto the floor. You will most likely have to trial this with a couple of dry runs.

If you are more experienced you may simply wish to plug the bottom of the action screw holes in the stock with balls of plasticine. But again, these need to be fitted in such a way that they will fall out easily, as the headless screws pass through the action screw holes of the stock. I also think that, no matter how experienced you are, it pays to take a felt tipped pen and mark the hole locations on the top line of the stock as a basic reference guide. It is important to think this over. If you lose track of where the holes are, you will end up lifting and dropping the action up and down until you find the holes by which time you may have dragged plasticine from the magazine well forwards into your precious bedding area.

Once the stock is finally and fully prepped lay newspaper under the stock. If the stock has been held in a vice (mag well), it should be repositioned so that the vice is holding the forend with blocks of wood under the butt stock to set the stock level.

Above, my skirts and secondary foam dam are in place. I have folded the tape over the foam so that I can grab and pull it away without having to use two hands. Steph is just beginning to pour the compound. When the compound has settled I will guide the action via the headless screws down into the mortise, pushing the action down (very slowly) until it is just touching the foam dam. I then pull the foam dam, then push the action down to its final resting point in a slow steady motion.

Summary of Key Points:

- Trial fits.
- Replace marred tape.
- Degrease stock.
- Tape skirts.
- Temporary foam dams.
- Block action screw holes with either tear drop plasticine or guide straws (top of straw closed off).

4. Action preparation second phase

The action now needs a final degrease, after which you will apply your release agent to prevent the metal work and stock from becoming a permanent affair.

First, remove the headless screws and inspect the tape and decide if they need re-taping. If you are having trouble getting the masking tape to adhere to itself as you roll it around the headless screw (due to oil residues from your fingers), you can run a line of nail polish down the outer seam after rolling the tape and fitting it to the headless screw.

Again, use brake cleaner to remove any oily residues from the action. After completing this task you can apply release agent to the action and the headless screws. After the release agent has dried you can refit the headless screws.

When applying MatchGrade Release Agent it is important to dab the release agent onto the metal work, rather than painting it on. You will probably find that you apply too much when you first try your hand at this. By continuing to use a dabbing motion you will see the agent gradually even out to a fine layer.

The release agent needs approximately 20 minutes to dry hard; however, in warmer weather this time is reduced considerably. A heat gun can also be used to speed up the process. To make an action extremely slippery after the release agent has set I highly recommend dusting the metalwork with powdered graphite. This can be buffed using a soft artist brush or blusher brush. She will think you are a true romantic, if you buy her a new brush before using the old one.

Summary of Key Points:

- Remove headless screws.
- Degrease metal work.
- Apply release agent to action and headless screws.
- Refit headless screws once release agent is dry.
- Dust with powdered graphite.

5. Bringing it all together

Finally it is time to mix and apply the compound. If possible, utilize two people. Your wife will want to be involved anyway, now that you have proven your romantic prowess. Add part B to part A and mix well but not vigorously, in order to avoid creating lots of air bubbles. The compound can be warmed with a heat gun to help remove air bubbles, but be careful not to go overboard with heat and set the compound off too quickly. Short bursts are the key.

For those who wish to go the extra mile, a vibrating sander can be used to help minimize mixed air bubbles. You can place a piece of polar fleece over the rubber backing pad of the sander to help protect the rubber. The sander can then be held upside down in one hand, the

other hand holding the punnet of compound against the vibrating pad. Do not go overboard with this as you will risk sending the metal filler to the bottom of the punnet.

Some of you may wish to have a quick cup of tea (or whisky) to calm nerves prior to the final thrust. I designed the compound to have a long open time of around 30 minutes before it tacks off, so that we would not have to rush the last stage. The compound will however tack off quickly (under 20 minutes) in hot climates. So, if you want a short 5 minute break to sit and observe which I highly encourage, now is the time.

The next step is to pour the compound. As mentioned previously, the stock needs to be in some form of a rest at this stage. Use either a vice or if working within your home, a small cardboard box with v shaped cuts at each end to serve as a rifle rest.

When pouring the compound, collapse the container so that the mouth of the container has a fold in it, allowing the compound to be poured in a thin, continuous drizzle. Allow the compound to migrate slowly into recesses.

Ensure that the compound is worked and forced into keyed areas and or drilled holes. It is critical at this stage that all plasticine dams are in place and able to perform their function: preventing compound from running out of the magazine well, trigger well, and stock forend channel.

If you are bedding a Hogue stock, it can at this stage pay to carefully lay chopped carbon fiber or fiberglass (or chopped and degreased pig bristles) against the side walls of the rifle stock. A half teaspoon of chopped fiber is more than enough for the job. I tend to paint compound onto the stock inner wall, then lay the chopped fiber, then pour in the balance of compound. The fiber will give the bedding directional strength, where before its primary concern was compression

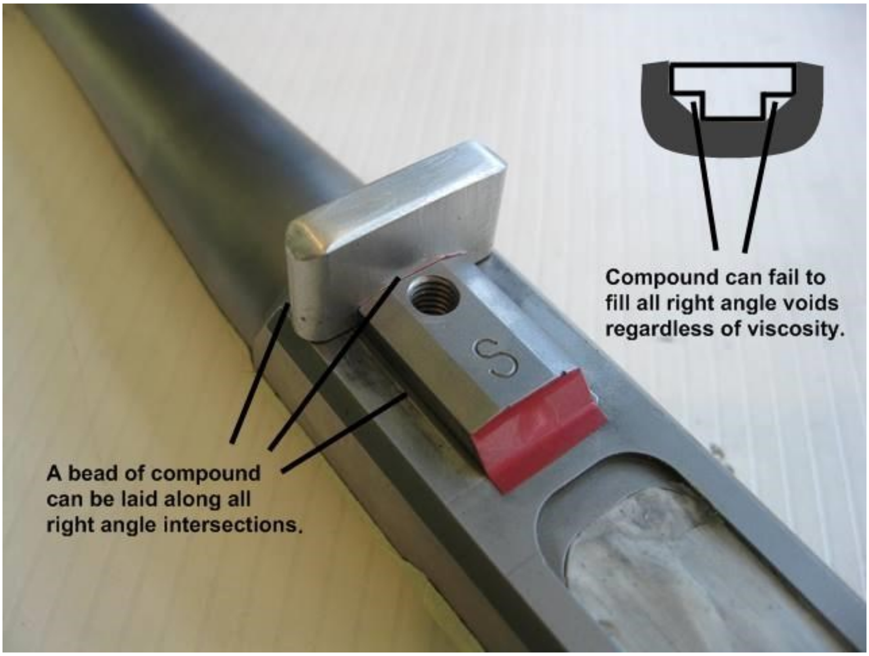
strength (including recoil). Our bedding compound does not contain chopped fiber, because our trials have shown that if the compound is fully laden with fiber, its migration properties are ruined, resulting in huge air pockets. The careful application of chopped fiber is much better in this regard. The Hogue stock does not have to be bedded with fiber against the rubber walls; however, I believe this really beefs up the entire design (especially with strong as steel carbon fiber), as I am sure you will agree.

Pour roughly 90% of the compound into the stock.

Once the pour is complete, you can warm the compound again with a heat gun, utilizing steady sweeping passes. Use the same motion as a fighter plane during a strafing run, start high and away from the stock, come in low and heat the length of the bedding compound (about a 4-5 second pass) before finally lifting off again. Also, if you are cunning, you can use a vibrating sander, held against the underside of the stock in the area of the magazine well. But to do this you must make sure that the stock is well taped and that your straws or plasticine do not fall out of the stock during vibrating. The stock also needs to be held securely in a vice and or pushed down from above by a helper.

The more heat you apply, the more you will remove any trapped air from the pour. But the more heat you apply, the shorter the open time, which can come down to 10 minutes working time under heavy heat. Try to keep your strafing close to the job, single pass wait, single pass, wait and so forth.

Without any heat, in winter conditions, it can take over an hour for the compound to begin to tack off. I do not recommend cold pours. If you are in a very cold climate, I would suggest that you heat your work area or sit the compound on a warm hot water bottle during mixing, as it is hard to remove trapped air otherwise.



A Sako A7 partially prepped for bedding. You can see the right angles that can trap air and require the manual application of compound, but note also the front action screw hole. In this case, the screw is so close to the recoil lug that it pays to paint compound between the headless screw and recoil lug in order to avoid trapping air. Always keep an eye out for air trap points like this.

You can now take the remainder of the compound and apply it to the rifle action. The compound should be painted onto any right angle intersections. It is important to understand that as much as I have tried to design an optimum viscosity bedding compound, due to the very nature of epoxy resin the compound can struggle to fill right angle voids. We are immensely pleased with the behavior of MatchGrade Bedding Compound and it does do a wonderful job of migrating into

complex shapes, especially recoil lug intersections which it does flawlessly. Nevertheless, it still pays to take precautionary steps, especially with more complex action designs. I suggest that you lay beads of compound within right angle recesses to form chamfers. It can also pay to paint compound around the intersection of the headless screws and the action as well as painting the tang, especially if it is of a more fiddly design (Mauser, Win M70). You can also apply chopped carbon fiber, fiberglass (or our pig bristle mix) to the tang if you are concerned about having a low volume of bedding compound at the tang.

Once you have finished attending to the action, check to make sure your beads of compound have smoothed out (use a heat gun). The beads of compound need to settle into nice chamfers with no convexed round edges (blobs) that may in themselves trap air. The painted on compound should not look like great big chook droppings!

You will now need to make sure that you have your bungees on hand - cotton buds and towelettes within arm’s reach. Again, you will need newspaper under the job. When you are ready (How many whiskies have you had now? Or is that “wishkeesh” now?), place the barreled action over the job, and slowly drop the action into the mortise. Descend slowly until you are just touching the foam dams. By now the straws or plasticine plugs will have fallen out of the action screw holes in the stock. If you have a stuck straw, pull it from underneath. If your headless screws bind in the action screw holes, pull the action back out and re-attend to the screws. If you force the action down, the job will turn sour - period.

If you want to, you can have a helper give the bedding one last pass with a heat gun while the action is still a half inch above its final resting point. Then when you are ready, pull the foam dams and push the action down to its final resting point in a steady smooth motion.

The completed pour.

Once the action is down in the mortise, keep a thumb on the rear of the receiver (where the rear scope mount would sit). **Do not alter pressure.** If you have a helper, he/she can clean off some of the surplus compound from the sides of the stock, remove the tape curtains, then fit your bungees. If your wife is helping, she may (if she is patient enough) wish to read these instructions before you have even poured the compound to double check your prep work. Women have an excellent eye for detail, so do not underestimate the potential of a female accomplice!

When applying bungees made of inner tube, try to make your bungees thin. I cut my inner tube into strips about an inch or so wide, then

double it over to keep it narrow. If you have very wide bungees, you will have difficulty with the cleanup.

Do not use G-clamps or other ‘severe’ devices which may stress the action. The action should simply be strapped in place, first at the rear (again, rear scope ring point), then the front. Make sure the bungees do not interfere with the headless screws. Set the bungees firm but not overly tight. You will know if your bungees are too loose as the tang will try to rise (without a forend tip pad or dam). The bungees need to be just tight enough to keep the tang down, and if you have used a forend tip dam (especially recommended for long heavy barreled rifles) you will have no trouble utilizing firm but not heavy tension. Remember, if we crank the bungees too tight and the stock is prone to flexing, we could create harmonic stresses. So, we must get this right: neither too light nor too heavy - using our eyes, using our common sense, observing how the action sits in the mortise.

Once the bungees are in place, continue cleaning the action. Also, make sure the action has gone down to its correct height. If the action is higher than normal by around 1 mm/40 thou, do not worry too much. If however you are bedding a Mauser, you may wish to try manually pushing the action down a touch, then reset the bungees firm (again not tight). If the job is sitting very high, something has gone wrong and the job is a bust. You will need to take your degreaser and immediately begin removing all compound before starting over. If the job is slightly too low, you may have to trim your magazine box to suit the new action height unless you wish to start over.

If all is well, continue cleaning up the surplus compound that has overflown from the stock. **While doing this leave a small bead of bedding compound proud along the top edge of the action and barrel.** The bead should be about 2 mm or 80 thou in height. Failure to leave some surplus compound on the top edge may allow suck back to occur

during the curing stage. By the same token, if the bead is too large (high) it may trap the action in place. So, make sure the bead is small. Do remove all compound at the tang - do not leave a bead, otherwise the action will be trapped in place. At the ejection port of M700 rifles and similar type actions, do not leave a bead, as this is another trap point.

As a side note for those who prefer a stiff mix as opposed to the more commonly preferred runny consistency, the compound can be warmed by placing the mixing bowl on a hot water bottle. At high temperatures the compound will begin to stiffen dramatically around the 10 minute mark and become hard after 20 minutes at 40-60 degrees Celsius. Obviously the compound should be checked every few minutes to determine optimum consistency.

Inner tube bungee. Drape the bungee over the action, pull down, loop under the action, come back up and tie a knot at the top. Tension needs to be just firm enough to keep the action in place without exerting excessive force.

The Ruger M77 cannot be easily FL bedded due to the protruding trigger housing. FR bedding is recommended for this rifle. During FR bedding it can pay to leave the compound to stiffen before application, or alternatively lay the compound and then leave it to stiffen. It is also possible to utilize a mid-section “blob” for the Ruger M77 in this manner or by heating up a teaspoon of compound.

Ruger M77. A blob of stiff bedding compound in the mid-section can, once cured, help prevent middle screw stock compression. The trick here is not to get the compound in the magazine well where it might bind with the trigger housing.

Summary of Key Points:

- Mix compound, heat briefly, then leave to settle in punnet.
- Rest a few minutes.
- Pour compound into stock and heat and/or vibrate as an option. Apply chopped fiber if bedding Hogue.
- Paint compound into right angles of action. Can use

cotton bud with bud chopped off for this.

- Apply chopped carbon fiber if required.
- Rest another minute or two and observe.
- Put barreled action into mortise.
- Cleanup major surplus compound, fit bungees, cleanup remaining surplus until only beads remain.
- If front and rear bedding a rifle, remove surplus leaked compound from drain inside magazine well of stock.

6. Curing

The curing stage involves the use of post heat to help the compound cure, while helping the air release agent within the compound to do its job of removing minor air bubbles. I have found that hot water bottles and blankets work best. You can also use 1.5ltr drink bottles filled with hot water. These heat sources need to be placed under and/or around the rifle. Use plenty of blankets or old coats/jackets to trap the heat.

I bet you all think I have a fancy post heat set up, some kind of hot box designed especially for curing bedding jobs. Well, I don't. You have to remember that most of what I do is about helping DIY users. I use the compound in the same way a DIY user employs it. My favorite setup is hot water bottles - one under the action, two on the sides, in triangular fashion. I use foil or a sheet of plastic wrap (greaseproof paper would be fine) between the hot water bottles and rifle to prevent gluing the hot water bottles to any surplus compound.

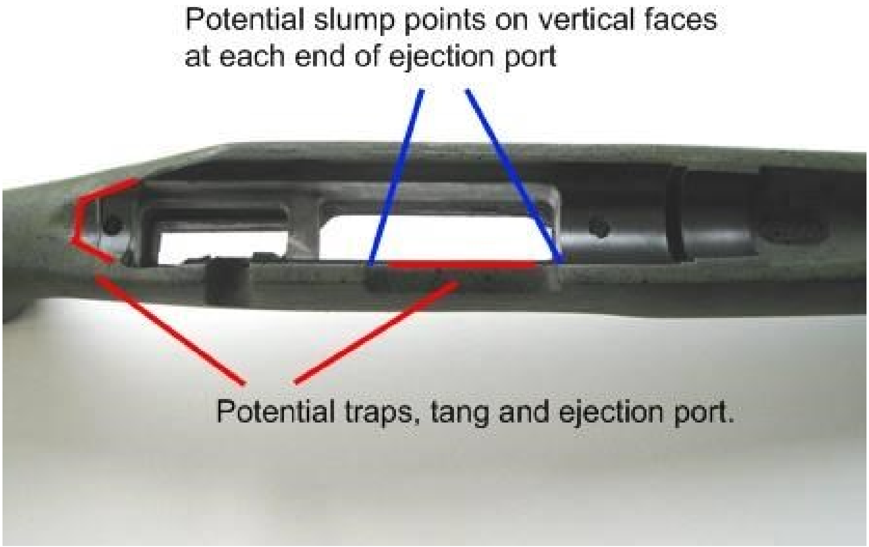
During the first 10 to 20 minutes of curing with heat the compound will soften and hopefully release any air bubbles that have been inadvertently mixed into the compound. However, if a large amount of

air has been forced into the job by human error during mixing or pouring, air bubbles may still occur within the job.

After 10 minutes of post heat check the rifle to see if the compound has migrated anywhere that it should not migrate. Check the tang again, check that the ejection port is not trapped, check each end of the ejection port on M700 rifles for slumping bedding compound that may need rebuilding. Check all beads, trim surplus compound.

At this point, with the compound in a toffee like state, you can if you wish use a hot knife to reduce the height of your beads, so that they are near level with the stock. You will of course need to make sure that you do not burn or melt the stock with a hot knife. The cutting of the bead will help burst any remaining small air bubbles that are trying to escape out of sidewalls of the stock and can make for a neat finish as well as making the job easier to pull after curing.

Once you are happy that the compound is tacking off and that no further migration will occur set the job aside under post heat for another five minutes. Perform one final check before leaving the job to fully cure.



Areas to watch during the curing stage.

With the trimming complete and the job now tacked off, the bedding compound must be left to post cure for at least 48 hours. During this time hot water bottles should be swapped once cooled. The ideal post cure temperature for this compound is 40 degrees C for at least 48 hours, however fluctuations in temperature as the hot water bottles cool are acceptable. If the job is pulled too early the mixture will be hard but brittle. The same will occur in cooler weather if the job is left for 48 hours but without heat curing. Once the compound reaches full cure, it will be both hard and tough.

If you are a dab hand you may wish to pull the job at around 15 hours cure time but you must ensure that the job has no lock points. Early pulls should only be performed by experienced operators due to the brittle nature of epoxy resins during the post cure stage. Just because it looks hard doesn't mean that the compound is fully cured through to its final tough and resilient form.

Summary of Key Points:

- Post heat is important.
- After applying post heat check job at 10 minute mark, remove trap points, leaked compound etc..
- Check again after another 5 minutes.
- Check again after another five minutes (compound should be tacked off by now with post heat).

7. Finishing the job

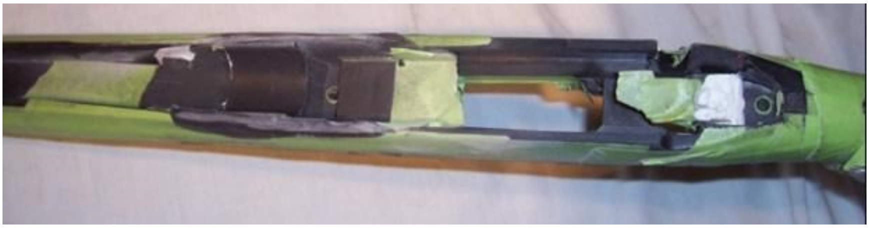
Once the bedding achieves full cure remove the bungees and anything that is binding the stock and barreled action together. Remove the headless bolts using polygrips or vice grips, if the headless bolts are not slotted for a screwdriver. Next apply two or three layers of masking tape to the underside of the barrel for protection.

Check again that no beads of compound have trapped the action. If a trap has occurred the bead must be very carefully chiseled off while taking care not to mark the stock or barreled action.

As a tip, if you wish to, you can spray the intersection of the bedding and action with CRC or WD40 to help break the bond. You will need to leave this sitting for several minutes, and it helps if the job is still warm.

Next, turn the rifle upside down, hold the stock forend in one hand and strike the barrel (protected with masking tape) with a rubber mallet until the job begins to break out. Following this, carefully wriggle the two pieces apart until fully separated. If a rubber mallet is not available, the parts can be separated by hand; however, the work is much harder and will require a good deal of brute strength. I would suggest a block of wood be used (fence baton in my case).

Breaking the job out



Initial view of bedding

The stock can now be cleaned up and finished. Use a sanding block and sandpaper to true up the top of the barrel/action channel. Commercial operators should use a variable speed angle/disc grinder (Fein, Flex, Bosch) with either rolocs or stickit discs. With end grinders, use stones rather than tungsten burrs during the cleanup/shaping stage.

Use a chisel or Dremel to trim and shape internal run offs. You will also need to drill out the action screw holes in the stock so that the action screws have plenty of play. I also use needle files which are great for squaring off finer surfaces for a neat, aesthetic appearance. Needle files can be very handy.

During the cleanup check for any electrical tape debris or bedding compound burrs that could upset accuracy. It is always best to use a craft knife or fine chisel to scrape all corners. Raised stampings (factory stamped letters and numbers in the metal work) that appear in the bedding should also be scraped flush. The breech face imprint should also be either scraped or chiseled as this area requires relieving.

Scraping away the breech face bedding (howa/Hogue). This area is just a thin line, about 3 mm (120 thou) wide. In the picture above, I am scraping from the top of the stock channel, right around to the opposite top edge. The line can be seen due to its slightly lighter shade from my previous pass with the chisel.

Some people tend to fall over at the cleanup stage due to either a lack of appropriate tools or patience. This is a time to take pride in your work: squaring of edges, carefully sanding the top line, and so forth.

One final job is to check and see if the barrel is free floating. I prefer a good float rather than a very subtle gap between the stock forend and barrel. Pressure point bedding at the forend should always be avoided unless a stress fault is occurring within the barrel.

With painted fiberglass stocks, you may discover that the top line of the stock needs re-painting where compound has been sanded and where sanding has gone through protective masking/electrical tape. If your stock needs a touch up paint, do not panic. Flat G10 (G10 being the flat sheen) enamel auto body paints can be used to touch up the top line; and as this is a low wear area, enamel lasts very well. If a superior strength is required, use an epoxy auto body paint. Auto body paint shops can easily mix small amounts of paint to match your stock.

If I am working with wood or laminate stocks I use teak oil to seal sanded surfaces. Even in areas I have not sanded or ground I make sure that all exposed stock internals are coated with teak oil, including the magazine well and forend. Danish oil is another option. These hardware store type oils are known as hard oils due to the fact that they dry hard and form a tough protective layer.

Summary of Key Points:

- Remove bungees and headless screws.
- Check for trap points again, chisel as required.
- Apply CRC/WD-40 if preferred.
- Shock open job.
- File, sand, grind to aesthetically pleasing finish.
- Scrape potential pinch points.
- Check free float.
- Protect exposed/sanded stock materials - touch up paint on glass stocks or hard oil on wood stocks.

Rework

Obviously the ultimate goal of bedding is to have flawless or near to flawless bedding jobs. But during the learning phase errors are bound to happen. If your job has suffered suck backs or major air bubbles due to human error, you will need to have a good think about how you wish to approach rework. In most instances these are aesthetic problems, not functional problems. You will have to decide whether you can live with these flaws, whether you want to attempt to fill holes, or completely re-do the job. I cannot answer this for you, but I will say that filling holes and suck backs is a tricky business due to potential migration of compound. As hard as we try, migration will often occur, the fresh compound ruining bedding tolerances. Nevertheless we can investigate a few rectification tricks.

Sidewall suck backs can be filled by painting fresh compound into the gaps (rough up the surface first). Do not fill holes proud, as migration will always occur. After shallow filling refit the action into the stock and complete the task by drizzling compound into the side walls from above. You may need to use a warm to hot wire (or needle), the compound running down the needle into the void. Again, I do not like this method due to potential leaking, so after curing double check to see if the compound has migrated. If so, subtly sand back the offending area enough, so that it does not interfere with critical tolerances.

It is also possible to use our old friend we used for mock bedding - the auto body filler. You could possibly dye this with a pinch of powdered clothing dye and use it to fill smaller holes. Little tricks like this can be made to work with great satisfaction, but you must remember that you are addressing aesthetics and not function. And when addressing these aesthetic issues, there is a risk of negatively effecting function - therefore effecting potential accuracy.

If the job really is a bust, do not muck around with aesthetic fixes. Take a deep breath, let it out, take your end grinder or Dremel and remove the bedding job in preparation for a full rework. I have seen people try to cover mistakes with paint and all sorts of other tricks - a right dog's breakfast. Don't do this to yourself or your rifle!

Extra tips for military bolt actions

When bedding the Mauser or Springfield rifle, it can pay to leave the magazine well/ floor plate area clear of plasticine or tape until you have finished trial fits. This will allow you to check the height of the magazine box (set to a very fine gap) and also the alignment of the front action screw. You will notice that because the floor plate assembly has a built in pillar, without the floor plate in place you are very much reliant on your barrel channel dam for correct positioning of the action and alignment of the front action screw. To this end, use your barrel channel dam to obtain alignment, all the while checking that the action screw is properly aligned to the floor plate. Once you are done you can remove the magazine box/floor plate assembly, then close off the bottom magazine well with plasticine as per normal. The sometimes gaping hole in the stock where the front action screw passes through can be plugged with plasticine, leaving a hole just wide enough to pass your headless screw through. If you do not do this the compound will drain out through the gaping hole.

The Mauser (M93-98 models) and Springfield rifles generally feature a large hole in the stock for the front pillar which is a part of the bottom metal. This is a potential drainage point for bedding compound and must be addressed accordingly.

The recoil lug of the Springfield rifle is somewhat fiddly, having a small cross section. The bottom, sides and front of the recoil lug need to be tape relieved with electrical tape however if you find that the sides and bottom are simply too difficult to tape, paint bright colored nail polish onto the relief surfaces, then apply release agent over this. After you pull the job, use nail polish remover to clean away nail polish.

Once the Mauser or Springfield bedding job is complete, check to make sure that the magazine and pillar do not touch the action. Disc off magazine or pillar metal and touch up blue as required.

The SMLE is a bit tricky in that the action fits into the stock at an angle. The action cannot be pulled away from the stock in a vertical fashion - a potential trap when bedding. The key area to watch for is the round action boss which acts as a recoil lug, and on the No.4 series, the right angle steps on either side of the breech. The boss (lug) needs to be relieved with plasticine to prevent locking the job in place, leaving only a hint of material in contact with the bedding surface as a point for return to battery. The front faces of the right angles found on the No.4 need to be relieved with electrical tape. If possible, try to bed all of the action forwards of the magazine well, then full length bed the flat underside of the action back to the body socket (the band between the forestock and buttstock). Headless screws cannot be used when bedding SMLE rifles due to the angle fit. Instead, the barrel channel dam must be used for alignment. This requires great care and multiple trial fits, checking the alignment of the action in relation to the bottom metal and action screw.

Those of you who are more patient may also wish to FL bed the side walls of the action all the way to the body socket. But please be careful regarding potential trap points!

The rear face of the SMLE forestock is supposed to butt up against the body socket. A steel strap across the rear of the forestock is designed to take recoil. This is in essence the recoil lug of the SMLE. Personally I do not get too carried away with the fit of this part, if I have bedded the action in such a way that the tip of the action boss is able to take some recoil - regardless of plasticine relief. But in some cases I have had to bed the rear as a separate operation in order to maximize potential.

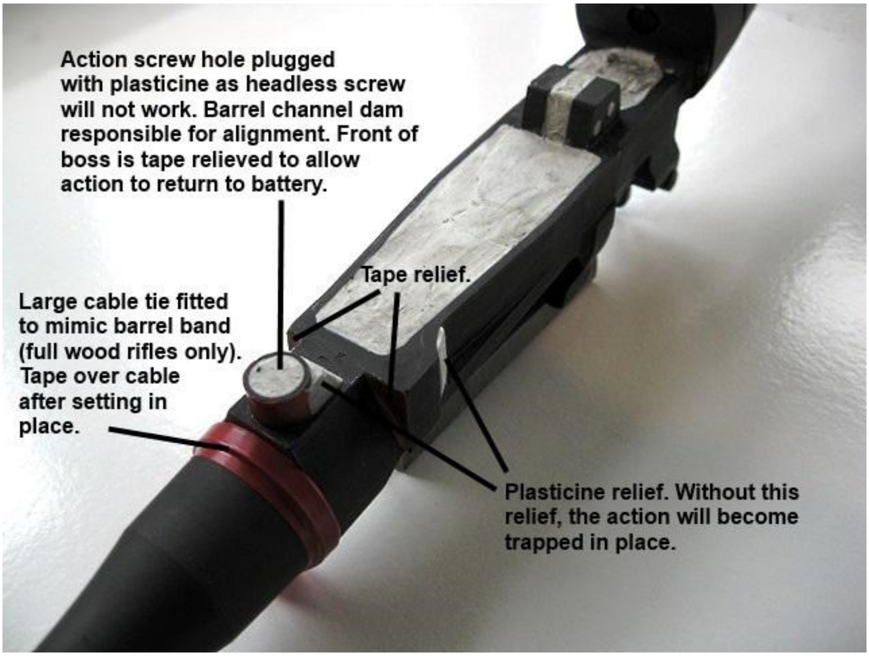
If bedding fully wooded No.1 rifles, bed the beginning of the barrel, then bed the barrel band sections, trying to avoid any form of pressure point bedding. The barrels of these rifles are already trapped, all we

want to achieve is to make sure that the captive barrels are under no stress.

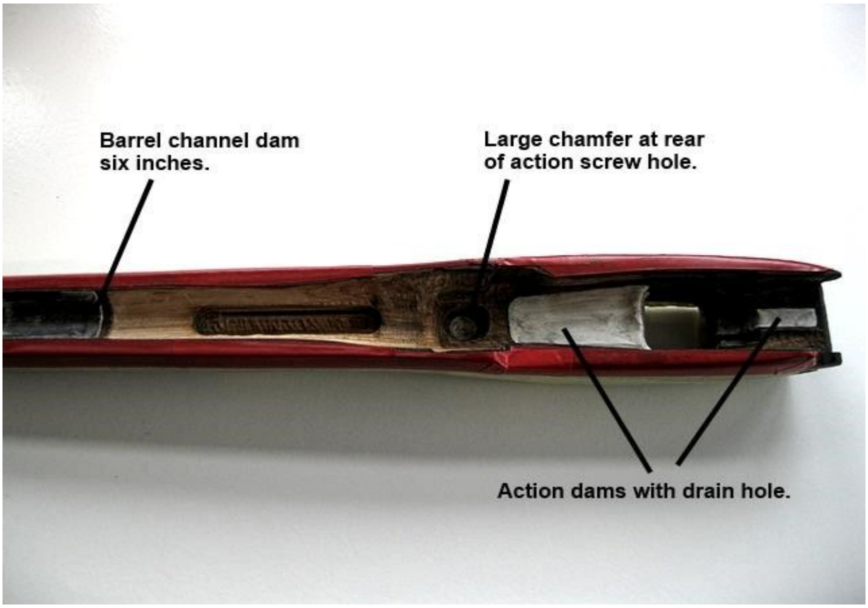
If bedding the No.4 series rifle, it pays to bed up to 6 inches into the barrel channel. This rifle is supposed to have a free floating barrel (from about 1” into the barrel channel). In reality, as soon as the rifle is laid over a pack or sandbags, the long forend comes up and touches the barrel at the nose cap - a very annoying tapping sound that lets you know that the fore wood has plenty of flex which may negatively affect accuracy. After bedding, the forend and nose cap need to be inletted to ensure that the barrel remains free floated beyond the barrel bedding. The rear of the trigger guard (bottom metal) also needs to be bedded (No.1 series through) as there is no rear action screw to supply a clamping force as can normally be achieved. I normally shim the front of the trigger guard so that it is sitting high by about the thickness of a business card. I then bed the rear of the trigger guard (rifle upside down), fitting the cross screw in place - but not the main action screw at the front. I do not bungee the job in place, nor do I push the trigger guard down hard into the mortise.

Following bedding and free floating, the rifle can then be tested for accuracy. If groups are still wide, it is possible to bed the top wood for a short distance (around 3”), its position being above the last 3” of the barrel bedding on the underside. After bedding the top wood the barrel band will clamp the barrel in place, much the same as a barrel block target rifle design. However, do not be quick to blame the bedding if accuracy is not optimal. Make sure that the muzzle of the barrel is crisp, bore quality and condition may also be a limiting factor. The rear locking lug design can also limit or dramatically effect performance. It is therefore important to experiment with different loads and bullet designs when searching for optimum accuracy in the Lee Enfield.

Those of you who wish to experiment with a greater float should bed roughly 1.5” into the barrel channel, then adopt a more aggressive forend inlet in the hope of obtaining a free float. You may find that regardless of attempts to float the barrel, the parts still touch and produce negative results when test shooting the rifle. In this instance a second bedding pad must be installed at a midpoint between the bedding and first barrel band. This modification will need to be performed in a manner that is complementary to the existing bedding - without placing any upward force on the barrel. Personally, I find that it is better to bed 6” into the barrel channel in an attempt to minimize stock flexing.



Basic preparation of the SMLE No.4 Mk 1 rifle action.



No.4 Mk 1 stock preparation.

The completed bedding job. With aperture sights, this rifle shoots .6 MOA with the Hornady 150 grain .312" SST bullet.

If bedding a sporterized Enfield (cut down forestock), bed 1.5 to 2.5” into the barrel channel.

All SMLE rifles with triggers hung on the bottom metal are height critical during bedding. If the height is altered the trigger pull changes. If you find that your trigger pull has changed and the rifle has a degree of collector value (even though you have just altered the rifle and affected its value), I suggest obtaining a second trigger which you can then experiment with without potentially damaging your original unit. Either way be careful when altering the SMLE trigger, baby steps with plenty of trial fits and trigger tests. Set aside a good couple of hours for this job and be prepared to disassemble and reassemble the rifle and trigger many, many times. The SMLE trigger has two cam lobes, the lower lobe is for the first stage, the upper lobe controls the second stage of the trigger pull. If you have altered the height of the action during bedding, you will probably find that the trigger is now single stage - one long horrible pull. It is imperative that you remove the forestock, then reassemble the action and trigger guard, then study the relationship of the parts before beginning any trigger work.

The Mosin Nagant rifle is fairly straight forwards to bed, the main oddity being the fact that the tang action screw goes down through the tang and screws into the floor plate - not up in the traditional way. I suggest omitting a rear headless screw during bedding, relying on careful fitting and plenty of trial fits to determine optimum alignment.

8. Bedded rifle re-assembly

Having already addressed basic rifle assembly within this book I will simply re-iterate some of the main points. A key element at this stage is to avoid hurrying the assembly process. You need to treat every step of assembling the rifle, as if it were as critical as the bedding job you just performed.

The action should be greased to help ease fit as well as protect the action, helping to seal the action from the elements. My current preference is to simply use lanolin based grease on the bedding surfaces, rubbing on a very light layer. Lanolin is harmless to cured epoxy and while we have had equally good results with oils and other brands of grease, it has been said that over extremely long periods of time there is a risk that some petroleum based products may gradually etch synthetic compounds.

Next, fully assemble the rifle and check the magazine box and trigger fit. If the magazine box needs altering (e.g. Ruger), then perform this task - but as described previously. Make sure that the magazine box has been fitted correctly before you start removing metal - it could be you at fault, not the metalwork. If the trigger is touching the trigger guard, you may need to remove material from the trigger guard. You will also need to check that the root of the bolt handle contacts the action for full locking lug alignment, removing any offending stock material.

Observe the fit of the action within the rifle bedding. If the fit is too tight, the rifle may produce fliers or stringing. In essence, the two parts should simply 'fit like a glove'. In some instances a tight fit will occur, no matter how hard we try. You must use your common sense here. There is such a thing as firm or tight but operable versus extremely tight. Make sure you grease the action or bedding to see how this affects fit. If the fit is extremely tight you will see scraping which is a real no-no. In such cases it is best to relieve the side walls with sandpaper or scotchbrite, counting each pass, so that the same number of passes can be used on both sides of the action. Use a fresh pad or sandpaper on each side. If you have any doubt, test shoot the rifle and observe groups. If double grouping occurs, follow the steps given in the double grouping section of this book.

As described in my first book we can also perform the 1 o'clock test at this time. As a quick recap: Hold the rifle, so that the barrel sits at the 1 o'clock position. Next release the floor plate or if the rifle has a detachable magazine, remove the magazine. Following this, with the action screws both tightened, loosen the front action screw a half turn, then tighten it a half turn. As you do this, check for any movement between the barrel and stock forend. If the barrel appears to rise, the action is under stress. This may have been caused by stock flexing during bedding. It may be that the magazine box (non-detachable types) is sandwiched in place due to height problems or basic misalignment during reassembly.

Once you are happy with the fit you can set about greasing the metalwork of the rifle. Although I have suggested grease you may instead wish to use something a little more tacky, such as CRC Soft Seal. If you choose to go this way, you will need to remove grease from the bedding (from your initial fit tests). I generally use grease for its ability to lubricate (return to battery) along with its protective qualities, but if the rifle is to be stored for a very long time or to be used in extremely harsh environments, CRC Soft Seal is sometimes the better option.

Apply a thin coating of grease (or CRC Soft Seal) to 100% of the bedding/action contact surfaces in order to avoid altering either the fit or tolerances with a potentially negative effect on accuracy. You can also now remove the tape from the muzzle of the rifle. The bore will need a good clean to remove any bedding compound dust and solvents. It is extremely important that the bore is cleaned and then re-lubed with an protective oil in a timely fashion. As an example, you may have used brake cleaner for degreasing the metalwork of your rifle. If this enters the bore it will remove protective coatings. If the barrel is chrome moly, it may begin to rust within hours without protection.

Greasing the action and magazine box. I have rubbed this grease on by hand but used an artist’s brush in the magazine well. Once the rifle is assembled surplus grease will be wiped away above the stock line, leaving a finer coating.

Check that the trigger is properly lubricated with a light viscosity lubricant which offers good corrosion protection.

The last jobs will include checking action screw torque settings, cleaning the bore, and refitting optics. If you have done any extra sanding you will need to remove grease from the barrel and action to ensure no crumbs/dust will be trapped in the job. Do not lose patience at this stage, simply clean the action and stock, re-apply grease, then reassemble the rifle.

By the time you are finished re-assembling the rifle you will have found this final stage to be quite a lengthy process, but having left no stone

unturned, you can be assured that you have done your very best to ensure optimum accuracy. You will have a sound, sturdy and reliable rig.

If you have already broken in the barrel and performed basic load development during preliminary testing, you can now move onto resighting in your rifle and or fine tuning loads.

If you have not yet tested your rifle or broken in the rifle barrel, you can start back at the barrel break in section of this book for advice on methods and test procedures.

A stabilized and FL bedded Tikka T3. Good preparation with both a hot knife and hot wire ensure excellent bonding of MatchGrade Stock Stabilizer and MatchGrade Bedding Compound to plastic stock materials, resulting in an immensely accurate and reliable rifle.

A Howa (Weatherby Vanguard) bedding job in a Boyds laminate stock.

Remington M700 Sendero FL bedding.

An excellent result. This client rifle started life as an off the shelf M700 SPS 7mm Remington Magnum. The rifle was recrowned and mock bedded (see earlier mock bedding photo), then tested. Results at the range were poor. Following this, the rifle was fire lapped which brought everything together. This allowed me to commence bedding, then fine tune loads further. The stock is one of my favorites, the old style Sendero stock still made by HS Precision (code: PSV029). Although designed for a varmint contour barrel, this stock mates well to sporting contour barrels. The stock forend is wide for excellent grip to aid comfortable and accurate shooting, yet the overall stock design is not bulky. This is one of the best rifle configurations I have come across for a mid-weight rig that can be carried afar without becoming a burden and can be shot in a very comfortable manner. It is also a very basic project.

Summary of Key Points:

- Grease metal work (including mag box and floor plate) and check fit.
- Perform 1 o'clock test.
- Remove any newly discovered pinch points.
- Assemble rifle and check to see if magazine or trigger is pinching. Relieve as necessary.
- Check root of bolt handle. Relieve stock as necessary.
- Remove and re-apply grease, following any sanding/modifications.
- Final assembly.
- Fit optics.
- Take it slowly.

Part 2 - Ongoing rifle maintenance

In part 1 of this book we looked at setup procedures, working towards optimum rifle accuracy and long term durability. You may have found that you had to repeat some of the steps provided, working your rifle over and over until you obtained a desirable result.

The second section of this book deals with long term maintenance. To this end we need to have some clearly defined goals. These include:

- Maximize bore life.
- Preserve metal work.
- Preserve optics.
- Preserve stock.

Our two primary goals are to maintain accuracy for as long as possible while preserving all other aspects of the rifle.

Many times I have seen fairly well preserved rifles that look to be in good order - only to find that the bore was poked well before its time. Many folk tend to focus on the areas of the rifle that are seen, giving little or less thought to the bore which is not seen. You would not be doing this because you have a thorough understanding of the importance of the bore!

Before we begin on our maintenance journey I would like to talk about gun vices. For many years now I have used a regular bench vice with padding, all set and blocked, so that rifles can be mounted in the vice at an ideal height and not fall through the jaws. I have stayed with this set up due to the fact that Steph and I use the same vice for bedding jobs. We also have a long flat bench which I lay the rifles out on for dis-assembly and so forth. I will admit that although the vice is essential for much of my gun work I generally do my bore cleaning and polishing work on the flat bench rather than using the vice. These days shooters

have dedicated gun vices. If you have the room for and can afford one of these, a gun vice can be very useful. If you do not have a vice, use a long flat bench and place a rag under the rifle action and optics. This set up is entirely sufficient for gun maintenance; provided the rifle is not pushed back and forth across the bench and the optics are well protected.

I have a bore guide which is essentially a tube of plastic which blocks off the action. The bore guide prevents solvent dribbling into the action and also aligns jags to the bore to prevent chamber damage. Having said this, the internal diameter of the bore guide can make things difficult when using poly pads. I therefore only use the bore guide in situations that allow its use. I do not believe this is an essential item, its main strength being its ability to keep copper solvents out of the action.

If I am concerned about a jag damaging the bore or chamber, I will take steps to chamfer and debur any right angles etc. That said, the brass shank of a jag is very soft and will not generally harm the bore - a good deal of force would be required for this to happen. Nevertheless, chamfering and deburring add an extra safety margin. The twisted soft wire of a bronze brush jag can at times have a wide loop at its tip. The loop can be collapsed a touch with pliers, any burrs sanded away.

For general dis-assembly work, I use a good quality screw driver set, the driver has a fat handle to help prevent RSI- something I have to consider as a commercial operator. The driver heads are interchangeable and can be replaced if the driver heads become marred. I also have a good set of allen keys and my ever handy torque driver set. Pin punches are also an important part of my kit for trigger work.

Some of my most basic tools. Note the calibration card supplied with the FAT torque wrench.

Step 1 - Bore preparation for field work

There are two ways in which we can prepare a bore for field work. The first is to run a clean 4x2 patch through the bore and shoot over what is called a dry bore. The second method is to shoot over a protective lubricant.

My general guidelines include the following:

- Chrome moly barrels - shoot over lubricant.
- Stainless barrels which foul lightly - shoot dry.
- Stainless barrels which foul quickly - shoot over lubricant.
- Stainless barrels chambered for throat burning cartridges - lube throat section only as an option.

Shooting over a protective lubricant is useful in two ways, obviously - protection and lubrication. If we are away in the hills and use a chrome moly bore, the protective coating will prevent corrosion. If you will recall my first book - it is possible to kill a chrome moly bore in one hunting trip without protection. Lubricant qualities will help reduce fouling and a degree of throat wear, thereby extending barrel life.

Whichever method you adopt, there are some basic rules which must be followed. To begin with the lubricant needs to be very light, so that it does not cause excessive hydraulic pressure within the bore which in turn could cause a barrel bulge. For the past few years I have been using CRC Long Life which has been very good. Before this I used Militec 1 which is a dry film lubricant (it dries out after application), designed to bond with the bore. Militec also make small bottles of action grease which is a boon. I found that Militec worked very well, but alas my supply dried up. I moved on to CRC Long Life but am now also using Fluna Tec which is another dry film, bonding lubricant. In other words, it bonds to the steel (like militec), then dries out. That said, one day I got a bit heavy handed on the outside of a firearm and there was no drying to be seen - my bad.

The main factor of concern to me is viscosity. If we are going to shoot over a lubricant it needs to be fairly thin or be of such a nature that it can be spread thin. Do not use Hoppe's as a lubricant as it is a solvent.

From my own experience high end dry film bonding lubes are very good. The dry film aspect of the lubricant prevents any concerns over the lubricant running away from the bore if the rifle is stood up on its butt. The bonding element cements this further. A dry film bonding lubricant can be ideal for both internal and exterior metal work in desert conditions where sand will stick to any proud or sticky residue. That said, I have also found that some of these lubricants require regular re-application. There are certainly pros and cons.

The hunter is not under the same pressures as a military operator and can therefore adopt more basic lubricants. I have been surprised by the performance of CRC Long Life which, as far as I understand, is a very basic spray lubricant without the addition of advanced technologies. Light gun oils can also be very useful, Rem oil and Ballistol being two very basic examples. I have yet to try Inox or Lanox aerosol products as shoot over lubes. Lanox utilizes natural lanolin, and this product provides excellent corrosion protection along with optimum lubricating qualities and therefore has potential merit as a shoot over lube.

I do not wish to get heavily into brands here because brands come and go. As long as we have an idea of what we need, we can always find something of use. Thin and slippery is the key while keeping an eye out for additional qualities.

As described in the barrel break in section of this book, bore lubes should be applied by passing a lightly coated 4x2 patch through the bore. I tend to swab back and forth, then finish by spiraling the patch around the chamber. If you are in any doubt as to film thickness, pass the wet rag across the back of your hand. Alternatively you can use the outside of the rifle barrel, if you have concerns about or allergies to lubricant chemicals. The film should be very light while providing full coverage. If you wish to, you may use a pull through for the task of lubing. Personally, I prefer to use a one piece rod to lube the bore before I go into the field.

Preparing shoot over lube on a patch. Unfortunately, I cannot condone this particular practice - who knows what chemicals are in our lubricants. Nevertheless, my method of testing rag saturation is to swab the back of my (dry) hand and observe residues. A fine residue lets me know that the rag is neither too dry nor oversaturated. The rag shown in this picture may look dry, but it has plenty of lubricant on it. For the more chemically cautious the rag can be wiped across outer gun metal - after swabbing the bore in order to avoid cross contamination.

The next step is to determine how the rifle will shoot with a bore lube. To do this you will need to perform 100 yard tests. You may find that your first copper fouling shot is so far off the mark, as to be useless past 200 yards - not good for long range work. If you have a stainless rifle you will be able to get by without a bore lube or by lubing the throat only. But if you have a chrome moly bore, you may have to have a strategy in place.

One way of rectifying POI disparity is to fire your fouling shot (or shots), then lube over the fouling. Following this you will find that your bore will remain protected while the next shot is much closer to the mark. Let's say we are planning a four day trip into the mountains. We know that the conditions may get rough, so we really want a protective bore lube. Before the trip we will go to the range to check the zero of the rifle. After this (say 3 shots), we then lube over the copper fouled bore immediately after the shooting session and are then ready to hit the hills in a few days' time.

You don't have to use a protective bore lubricant, and in some instances you may find the lube is counterproductive to accuracy. But in the interest of either throat or bore preservation (chrome moly) it is worth pursuing. There are many lubes I have not tried; I have even thought of trialing auto body wax one day - who knows.

While we are on this subject we may as well talk about moly (molybdenum disulfide) coated bullets. Moly coating can reduce fouling and can also reduce throat wear. The downside of moly is that the disulfide component attracts moisture and the resulting wet residue can be somewhat corrosive to the bore. A bore lube is of obvious benefit in this regard. In plain terms: if you shoot moly, investigate bore lubrication.

Summary of Key Points:

- Establish field preparation routine.
- Option 1. Shoot over lubed bore.
- Option 2. Shoot over lubed throat.
- Option 3. Shoot over dry bore.
- Bore lubing is highly recommended for chrome moly barrels during field usage.
- Establish POI differences.

Step 2 - Field care of the rifle

It is always a good practice to use electrical tape over the muzzle of your rifle to prevent debris from entering the barrel while stalking. A single layer of tape at the muzzle can be shot through without any negative effect on accuracy at intermediate ranges. The exception to this is the .224” bore which can lose accuracy, if muzzle tape is employed. On long range rigs I tape the muzzle but then remove the tape once I am in position for the morning or evening. I have yet to try the effects of muzzle tape when long range shooting.

I like to keep an eye on the bore, if I am away in the hills for a few nights. If the rifle has seen little use and depending on steel type, this may mean little more than a quick check. But if foul weather is at play or the steel is prone to corrosion (chrome moly), it pays to check and lubricate the bore each evening along. Some folk keep a pre-lubed rag in a pouch or snap locked plastic bag. I recommend a small bottle of lube. Many of you will remember when we used to simply keep the lubed rag in the butt of our SMLE rifles - those were the days.

With field kit you have a choice of a take down rod or pull through. To be honest, it is good to have both. The key factor to understand here is that a pull through cannot remove debris from the muzzle should the muzzle take a nose dive in dirt without tape protection (can happen during carcass retrieval). I currently utilize a Kleen Bore take down rod and a pull through. One of the most important aspects when choosing a take down rod, is to make sure that the rod will work with your barrel length because once a patch is fitted to the looped jag of the rod, the rod cannot be swabbed back and forth as can be done when a patch is wrapped around an undersized bristle brush. It is therefore extremely important that you select an appropriate take down rod. In most instances, you will find that you can fit your 4x2 patch to an undersized bronze brush and fit this to your take down rod. However if a looped jag is used, the rod can only be used in one direction. If the patch becomes stuck, the rifle may have to be taken to a gunsmith to be driven out. A stuck pull through is not so difficult as this can be fired out by using a cartridge with no projectile.

I have also seen hunters use curtain cord as stiff pull throughs. Nowadays such an item is manufactured under the Winchester logo. The advantage of the stiff cord is that it can be used to push through debris - to some extent, anyway. It is of course possible to sharpen a sapling stick to remove muzzle debris, but saplings do have a tendency to break and can make problems much worse!

A current favorite pull through amongst hunters is the Hoppe's Boresnake. Most folk tend to use their Boresnakes dry, but I highly recommend keeping the last inch or so of the snake oiled with a shoot over type lube for continued field use. Hoppe's make a neat little field pouch, containing the Boresnake, No.9 solvent, and a light gun oil which can be shot over, if applied carefully. The No.9 can be used to remove both carbon and a small degree of copper fouling.

Modern pull throughs often utilize a threaded jag system rather than a simply loop at the end of the pull through as found on traditional pull through designs. With a jag system, the tail of the pull through can be fitted with either a bronze brush, a mop or loop hole jag. My only concern is with metal jags. Try to steer clear of mild steel looped jags. Deburred brass or plastic is ideal but if adopting plastic, be sure to keep an eye on the condition of the plastic long term. Many solvents will attack plastic and gradually make it brittle over time. Modern pull throughs also tend to be caliber specific regarding the bronze brush diameter however the looped jag fitting can be used in a more universal manner providing it can comfortably enter the bore.

It really is important to keep a pull through on hand when in the field. This simple tool can prevent a great deal of harm. A take down rod tends to absorb more time to set up, this item generally being stowed in a pack while a pull through can be kept close at hand. When we are extremely tired from a hard day hunting in inclement weather, it can be tempting to set the rifle aside rather than rummaging through our packs, 'hoping' that the chrome moly bore of our rifle will survive the trip. A pull through, patch and oil kept very handy can make all the difference.

I have also seen very small bottles of WD40. This lubricant is very light, requiring regular re-application, but due to the size and ease of handling of the cans it can be immensely useful as a field lubricant.

The contents of your field kit will be largely dependent on the situation and also how heavily your rifle copper fouls. During one of our long range tutorials the client may burn through up to 60 shots or more, both on targets and game. In such situations it is best to pack full cleaning equipment, including copper solvents, a one piece coated (or carbon fiber) cleaning rod, bronze brushes and so forth. Thank goodness we take to the hills with quad bikes on our tutorials!

Ultimately, rate of fouling and round count will determine whether you need to pack a small bottle of aggressive copper solvent or a mild copper solvent (like Hoppe's) along with a shoot over lube. If you plan to shoot only one animal, there is no need for a solvent - a small bottle of protective lubricant will do and is an essential field item. If you plan to fire perhaps 20-30 rounds, a mild copper and powder solvent such as Hoppe's and a protective lubricant is ideal. If you plan to do some long range plinking and have a heavy fouling rifle, you may need to include an aggressive solvent plus protective lubricant. If you have a low fouling stainless bore, you may be able to survive your trip without any need to clean your rifle. But I do suggest some form of lubricant which can also be used as a cleaning agent - should your rifle take a nose dive!

I have in the past found Hoppe's No.9 (or Collings No.90) to be very useful in the field when Steph and I are away hunting. This serves as an excellent mild copper and powder solvent but not as a protective lubricant which must be carried separately. These days my kit includes a small bottle of Bore Tech Eliminator and a small bottle of CRC Long life which I spray into the bottle. Ballistol lubricant has merit as a powder solvent, a protective shoot over lube and as an antiseptic. Its dual role, offering a weight saving for those who normally carry a separate antiseptic ointment. There is of course a wide a range of solvents and lubricants we can use. These have been discussed in detail in both the preliminary rifle testing section of this book and will also be discussed just ahead within the bore cleaning section. The point I want to drive home here is that you need to base your field kit on your individual rifle and shooting needs.

My current field kit: 4x2 rag, take down rod and jags, a small bottle of Bore Tech (for high volume shooting trips), a Steyr AUG oil bottle filled with CRC Long Life, and a Steyr AUG pull through. Note the looped plastic jag at the end of the pull through. This pull through is specific to the 5.6mm bore but the looped fitting allows me to use this pull through on a wide range of bore diameters. I also carry a couple of poly pads for my take down rod, just in case I am hunting with someone who has a stubborn fouler (having been caught out in the past). The take down rod lacks a rubber coating, so I have to be very careful not to damage the bore when using it.

The keywords you need to become familiar with are mild solvent, aggressive solvent, and field lubricant, while learning to distinguish between all three. As suggested further ahead, several companies advertise products which supposedly work as both, a solvent and protective lubricant, but few (if any) achieve this in a meaningful

manner. Because of this you may have to double up your field kit to include both, a solvent and protective lubricant. Again, Ballistol truly has great merit as a general field lubricant for backpack hunting due to its dual role. Your cleaning/shoot over kit with Ballistol and 4x2 cloth can also act as your first aid kit (antiseptic and bandage). A solvent can be carried separately if needed.

Once you have established your needs the next trick is to find bottles small enough to hold your solvent and/or lube. I am currently using Steyr Aug lubricant bottles (I have also been using their pull through for a number of years). The Steyr kit bottles do however leak on occasion which is frustrating. Small essence bottles can be useful but most are made of glass which adds weight. Pill bottles can be equally useful, if the lids seal well. If you are using CRC Long Life as a field lube, I suggest you spray this into a small pill or essence bottle rather than haul an entire can around the mountains. The Hoppe's field kit is well set up with two small field sized bottles.

When using a pull through it is extremely important that the rope is pulled straight and not across the muzzle of the barrel. Keep an eye on the muzzle at all times when using a pull through - the aim of the game is to not let the rope touch or "lean on" the muzzle. Rope is a great cutting tool, so don't let your pull thorough ruin the muzzle of your rifle. Once the pull through is fed into the rifle place the butt of the rifle on the floor, hold the end of the barrel tightly in one hand, wrap the lead of the pull through around your other hand, and pull it through the barrel in one smooth, straight motion. The pull through will probably judder down the bore on the first couple of strokes until a patch is run through the bore several times. After removing powder residues the pull will eventually feel smooth and lubricate the bore.

Care of outer metal work will generally consist of wiping the rifle down with a used 4x2 patch following bore lubrication. Although care of outer

metal work is not as critical as bore care, chrome moly rifles deserve special attention in the interests of long term preservation. I do not generally carry grease into the field as such an item would generally add to the already long list of items in my kit. These days I simply use CRC Long Life on outer metal work, as used within the bore. If I have been hunting in wet weather, I first dry the outer metal work, and then swab the metal work with a used 4x2 patch loaded with extra Long Life. If the woodwork of a rifle has taken a hammering and is both wet and gouged, this also gets treated with Long Life as a temporary measure. In desperate situations, cooking oil, butter or fat can also be useful - the realities of hunting being far from an idealistic world of “shoulds”. Again, it is not difficult to see the benefits of Ballistol as an all-round field lubricant under such conditions.

The realities of hunting. Our packs and rifles were stored under a fly but a snow storm collapsed the fly during the night. Without solid preventative measures, the bores of these rifles could easily have been permanently damaged during the course of this hunting trip.

Summary of Key Points:

- Field kit is very important.
- Contents of kit dependent on time in hills/anticipated round count versus potential fouling.
- Be very careful with the muzzle when using pull through.
- Pull through very handy, but take down rod especially handy for removing obstructions.

- Learn to discern between mild solvents, aggressive solvents, and lubes.
- Pack solvent or lube into small containers to save weight and bulk.

Step 3 - cleaning the bore

Thoughts on bore cleaners

I recently had a look through the product range available at a U.S superstore and found roughly 160 solvents and 160 lubricants to choose from. What a confusing mess!

The first thing I want to establish is that there is a difference between a decent copper solvent and a lubricant or protective coating. Some companies promote products as fulfilling both roles but none achieve this role with 100% success. As an example, the main "gun oil" for the New Zealand hunter for perhaps eighty years was Youngs 303 cleaner and rust preventative. This was initially used by Commonwealth forces for the purposes of cleaning and rust prevention of the SMLE service rifle. I cleaned my rifle in the same manner as my father. Dad cleaned his rifle the same way as his father cleaned his rifle and so forth. The SMLE pull through had a gauze patch just before the loop in the tail. We fitted a section of 4x2 rag soaked in Youngs and pulled the barrel through fifty million times. Following this, the bore got a dose of boiling water from the jug which emulsified with the Youngs solvent and within a minute or so evaporated, removing all corrosive primer residues and leaving the bore neutralized. We then set about oiling the bore again with Youngs - another five hundred pulls. Sometimes I would mix the oil with boiling water as a cleaning agent, but generally I used the basic

oil/boiling water/oil method. Everything got cleaned with Youngs, and fortunately it was thick enough to work well for mid-term storage. The trouble was, Youngs is not a copper remover. It removed powder fouling and helped protect the bore, but it did not do so well with heavy copper fouling. About the only means we had to remove copper was via the action of the gauze with a small amount of etching from the solvent. I bet a whole pile of rifle barrels were binned over the years without anyone checking on copper fouling. Somehow we got by, perhaps due to loose bore tolerances minimizing fouling. I will never forget the smell of Youngs which I added to my aftershave list as a young (confused) man. I don't know the recipe for Youngs, but if I had to guess I would say that it had a pine tar base (Stockholm Tar). The current tins produced by Parker Hale state "new and improved formula" which is always worrying (like the Pears soap story).

Youngs enemy was Ballistol, used across the trenches by the German military. This had even less solvent action than Youngs but again, could be used or mixed with boiling water to remove corrosive residues. Ballistol was also selected for its performance as a metal, wood, and leather preservative. The formula also contained a dedicated antiseptic agent for field wounds. In its day Ballistol was viewed as the ultimate all around elixir, so much so that the U.S military took a keen interest. But alas, war put an end to preliminary negotiations. Many Germans continue to use Ballistol today as their fathers and grandfathers did. During the course of writing this book my editor noted that his father used Ballistol on cuts and scratches throughout his life.

Hoppe's No.9 has a very English looking label and sound to it, but it was developed in Philadelphia by Frank Hoppe based on his nine secret herbs and spices (the other Philadelphia experiment). Hoppe's was introduced in 1903 and has been a major player in the gun cleaning scene ever since. Here again exists a level of confusion. Generations of shooters have used Hoppe's as a bore preservative when it is too thin

for this task, offering poor surface protection. Hoppe's No.9 is in essence a powder and copper solvent, offering a very small degree of very short term protection. In rifles that produce very low copper fouling, Hoppe's is great for removing light copper fouling and heavy powder fouling (e.g. suppressed rifles). Hoppe's is doubly useful for low fouling stainless barrels, as it is possible to scrub the bore, then leave the Hoppe's to sit until the rifle is to be used again. This allows the copper solvent part of the brew to do its work without fear of damage to the barrel. Later, the bore can be given a good clean out prior to setting off into the field again. But on heavy fouling rifles Hoppe's can be extremely ineffective. Although Hoppe's can be left in the bore to do its work, a chrome moly barrel may begin to rust after a period of time if environmental conditions are unfavorable. But again, generations of hunters have used Hoppe's for gun storage due to an expectation that this product will both clean and protect. Many of these hunters had no clue what copper fouling was; all they knew was that the bore looked dirty after shooting but looked shiny after using Hoppe's.

As a side note for New Zealand readers, there was a time when Hoppe's was costly to import to New Zealand, as it was classed as dangerous goods. Collings and Bradey came to the rescue with Collings No. 90 solvent. This solvent was very similar to Hoppe's, in both action and scent, but extremely economical and without the extremely toxic chemicals found in the original Hoppe's recipe. More recently Hoppe's changed their formula, so that it could be exported as non-dangerous goods; and like the Collings formula it was redesigned with more user friendly ingredients.

Ultimately we need to develop a good understanding of what the 160 or so solvents have to offer. You also need to be aware that many shooters (especially those of older generations) don’t have a clue what copper fouling is or know the difference between a solvent and a lubricant. Because of this you must remain wary regarding product reviews.

To my mind, the two forms of gun solvent we can utilize are firstly the dedicated aggressive copper and powder fouling removers, such as Sweets and Bore Tech (and several others). The second type of solvent we can use is the non-aggressive slow acting type which offers a very small degree of bore protection. In this second situation, we plan to thoroughly clean the rifle later and are leaving the bore to soak for a few days (Hoppe's No.9). That said, if you have a low fouling bore, you can use a non-aggressive solvent as your main cleaner. And as mentioned, Hoppe's (or Collings) is very good for removing carbon from suppressed rifles.

In the past the most aggressive and effective copper removers have been products which utilize a high ammonia content. My past advice was that if it smells (from a distance!) like it's going to kill you, it's a good product. Sweets 7.62 lead the way for many years, a potent ammonia solvent. Today we have a few solvents which utilize other chemical reactions that are more user friendly. It has also been said that ammonia is very hard on bores - which is true. But this is only a factor, if ammonia is left in the bore for very long periods of time. Nevertheless, the new generation of copper removers such as Bore Tech is very effective, and in the last couple of years I have been highly reliant on Bore Tech for my commercial operations. More recently I have been using KG 12 and have achieved exceptional results when cleaning bores with stubborn copper fouling. Both Bore Tech and KG 12 tend to run, and I would prefer more of a gel like viscosity, but by continually swabbing the bore and keeping surfaces wet these solvents cut through copper. Of the two, I believe that KG 12 has a slight advantage in that its chemical reaction appears to continue over a long period, if the bore is thoroughly wetted and left to sit. The only downside of KG 12 is that it does not show any color reaction. Bore Tech shows a distinctive blue colored chemical reaction as an indicator of whether any copper fouling remains in the bore. Nevertheless, KG 12 is an exceptional performer.

While we are on the subject of KG 12 and the lack of a color reaction, it is important to be aware that there are other products which produce no color reaction - because the products are essentially useless. So, if you are in any doubt about products, I still suggest the use of ammonia as an ideal copper solvent base, treating new generation copper solvents with caution. Of the new generation non-ammonia based solvents, I recommend either Bore Tech or KG 12.

At this point, it is also important to address overly nervous barrel makers. Recently I had a hunter contact me regarding his high end European rifle. The hunter also shot light competition with this rifle which posed potential for increased barrel wear. The rifle maker had explicitly stated that no solvent should ever be used within their carefully lapped bores. The rifle manufacturer recommended light oiling only. In contrast to this, the hunter wanted to explore copper fouling levels. The trouble with the manufacturer’s extreme caution is that it does take a level of control away from the end user. A light solvent such as Hoppe's will not damage the bore. The bore can be left to soak for several days before being cleaned and swabbed with oil. A modern

Back row left to right: Bore Tech Eliminator, KG 12 and Hoppe's No.9. Front row: white poly pads, cleaning rod with worn down brush, new bronze brush and Bore Tech Chameleon gel. Although KG 12 is of the newer type non-ammonia based solvents, it still gives off an ammonia smell.

aggressive non-ammonia based solvent such as KG 12 or Bore Tech Eliminator is also harmless to the bore. I gave this advice to the hunter along with one additional pointer. It is all very well to leave the bore untouched - but if the throat remains unpolished, it will wear down relatively quickly with competition work. Common sense is the key factor here.

I don’t really know where Youngs sits these days, but I sure miss the smell. Maybe Youngs should simply be compulsory for SMLE cleaning for the sake of nostalgia! Youngs is at its best on rifles that produce low

copper fouling. The original formula left quite a gummy residue on steel, ideal for medium term storage and field use with regular re-application, but not as a shoot over lube. Youngs is certainly adequate for cleaning shotguns. There was a time when I wondered whether the Youngs recipe could be tweaked with a copper solvent additive. Now that would be a “new improvement”. By the same token, I also wished Hoppe's could be made as thick as Youngs for surface protection. I tried mixing the two together as a young man and merely managed to weaken the properties of each solvent - worst cologne ever!

I have yet to see a solvent company produce an all-round product that cleans, lubricates, and protects in an optimal fashion. I also believe it is unrealistic to want or expect this. The reality is, cleaning is not the same as protecting. Clean first, polish, then protect. Do not get the three operations confused, as many shooters do. If you wish to use a multi-purpose cleaner/protector, either employ it as an interim pre-cleaning step or utilize the product on rifles which produce very low copper fouling. For general carbon and copper removal, use a dedicated aggressive bore cleaner.

Summary of Key Points:

- It is important to understand the difference between cleaning and protecting.
- It is important to understand the difference between mild solvents, aggressive solvents and protective lubricants.
- Dual acting (clean and protect) products generally do not achieve optimum results.
- Modern, aggressive solvents (KG 12, Bore Tech) are completely harmless to barrel steels and can be used if

concerned about soaking versus chemical etching.

Bore cleaning method

After returning from the field, you will need to clean your rifle barrel.

If the barrel is chrome moly (blued), this will need to be done immediately. However, the reality is that most people are too tired to clean their rifles after returning from the field. So, we need to be realistic about procedures.

If you are exhausted, you may wish to simply pull the bore through with a protective oil and sit the rifle aside until you are recovered and can focus on the job properly. If you are completely broken, at the very least spray the bore with a heavy coating of CRC Long Life; but keep in mind that spray application is never as effective as full swabbing. If you have been hunting in wet weather, you will also need to spray the outer metal work (both chrome moly and stainless) with something like CRC Long Life or WD40 as a means to both disperse water and provide basic protection.

While the outer blasted surface of a stainless barrel is prone to rusting very quickly, the polished inner surface has a measure of resistance and can be set aside for some time before cleaning. Nevertheless, I still advise the use of some form of etching and light protection, and in the case of stainless a quick pull through with Hoppe's can help to loosen fouling while offering light protection. Hoppe's can also be used on chrome moly bores as a too-tired stop gap solution, but you must make sure you give your rifle a full and thorough cleaning within seven days.

When you are ready (hopefully sooner rather than later), you can get down to the business of cleaning the bore. If the rifle has been stored with a protective lubricant, this will need to be removed using brake cleaner or meths etc.

The next step is to remove carbon and copper fouling. If the rifle is suppressed, start with a coated or carbon fiber one piece rod, bronze brush and Hoppe's No.9. Use the Hoppe's to remove heavy carbon deposits, focusing on the chamber itself, the throat, and muzzle. It is imperative that an over-sized brush is used to clean the neck area of the chamber. If you shoot 7 mm, use a .30 caliber bronze brush and so forth. Once the heavy carbon is removed, you can then work on copper fouling removal.

If the rifle is not suppressed, there is no need to perform preliminary carbon removal. A basic aggressive copper solvent will remove carbon fouling as a secondary action. To remove copper fouling, again use your one piece rod and either a bronze brush or white poly pad. If the bore is a light fouler, you may wish to swab the bore with a 4x2 patch soaked in solvent (as you will see in many gun cleaning advertisements) rather than a bronze brush or pad. A 4x2 patch soaked in solvent is perfectly adequate for light fouling bores. It can also be employed on heavy fouling bores, provided a good solvent is used (e.g. KG 12) along with a good measure of time. A soft synthetic bristle brush can also be used in the same manner as a 4x2 swab. In contrast, a bronze brush or white poly pad tends to speed up the process via a scouring or etching action and ensures the removal of any unseen deposits. In other words, in lieu of a scouring action, utilize time.

There is no point performing any polishing at this stage, as we first need to remove the copper and carbon which is coating the bore.

One of the best aspects of a white poly pad (or 4x2 cloth) is that its white color shows residual fouling. If for example you are using

Boretech, the white pad or rag will show a blue residue if copper is still present within the bore. Some folk pass a fresh patch and fresh solvent through the bore with every pass, but I prefer to swab back and forth to get the most bang for my buck. I then leave the rifle to sit for several minutes, then change to a fresh pad or patch and start over. I also regularly visually check the muzzle of the rifle to observe fouling removal. Each bore is unique regarding rate and buildup of fouling, so it is up to you to observe patches and observe the muzzle as described in the barrel break in section of this book.

If using KG 12, you will not see any blue color. It is therefore important that you do not thoroughly swab or scrub the muzzle of your rifle, paying greatest attention to the extent of the bore. Light or occasional swabbing of the muzzle will allow this area to act as an indicator of residual copper fouling via regular visual inspections. Another factor to be careful of is to avoid leaving KG 12 to dry, such as if the rifle is left in direct sunlight. Once KG 12 drys, it forms a very hard lacquer like layer. It is therefore imperative to either keep the bore wet - or if it drys, apply a fresh solvent and scrub the bore with a bronze brush to break up the paint like layer.

During cleaning with a bronze or nylon brush and especially when using thin solvents such as KG 12 and Eliminator, a bore guide can be immensely handy for keeping solvents out of the action and magazine well.

Loading a white poly pad with KG 12.

One of the most common questions I am asked is: How long should it take to clean a bore? For example, what if it takes two to four hours of swabbing and soaking? Surely, this bore is taking too much time and needs to be lapped? Well, it is up to you to make the call on this. If your rifle is extremely accurate, there is not much point fire lapping it. This may potentially alter performance, if we get too carried away. If the rifle is inaccurate or suffering from an immensely high extreme velocity spread (ES), then we can surely consider bullet coatings or going back a few steps and fire lapping the bore. Just bear in mind that it is not the end of the world, if your bore is a stubborn fouler. It is no big deal on a Sunday to scrub the bore, walk away for an hour and let it soak, scrub, then leave the bore for another hour and so forth.

My worst rifle is my .375 RUM. The rifle is accurate, so I am loathe to fire lap it and have not yet experimented with bullet coatings. The last time I used this rifle I oiled it and put it away because I did not have time to clean it. Today (three weeks later) the rifle sat beside me, soaking in KG 12 solvent (as I typed the previous paragraphs). I left the rifle to soak for two hours, with occasional re-application and swabbing. I used a patch rather than a bronze brush, as this lengthy process would surely remove all of the bristles. Eventually, the re-application of solvent and occasional swabbing removed all the copper from the barrel. A last light streaking of copper remained at the muzzle as I only lightly worked this area (indicator). A final soak of the muzzle removed this final light area of copper fouling. Still, HBN coated bullets could make life easier.

One last thing I want to cover is heavy carbon fouling at the intersection of lands and grooves within the bore. For a start, I don’t believe that carbon fouling is a bad thing when deposits are very light (non-suppressed rifles). Carbon to some degree can act a bit like moly: Powder residue particles tend to be abrasive, but lightly caked carbon can be somewhat protective, as the bullet passes across its surface. Nevertheless, a continued buildup of carbon can have negative results. Most copper solvents remove carbon, but on occasion you may notice a heavy buildup of carbon at the intersection of the lands and grooves of your bore when viewed from the muzzle (especially suppressed rifles). This appears as heavy grey colored streaks with jagged looking edges when viewed through a magnifying glass.

If you have used a bronze brush for cleaning, the brush will have removed any carbon buildup. But if you use 4x2 patches or white poly pads, you may find that over time the bore has developed heavy carbon fouling with a gradually increasing negative effect on accuracy. Hoppe's No.9 on a bronze brush can be used to remove this buildup, but in worst case scenarios you may find that you have to get stuck in with Hoppe's No.9 poured over a maroon pad.

The same can be said of moly fouling deposits. Moly bullet coating can minimize fouling and also help minimize throat wear, but after a period of time moly will buildup and degrade accuracy. In this instance, use either Hoppe's No.9 or a dedicated aggressive solvent such as Bore Tech Eliminator and the bronze brush or maroon pad scouring procedures that I suggested.

Once you are sure that you have removed all fouling you will need to neutralize and remove solvents, using meths or brake cleaner, before moving onto polishing operations. It also pays to clean your bronze brushes at this point to prevent ongoing degradation of the bronze bristles as a result of solvent action. Brushes can be cleaned and neutralized with brake cleaner, meths, turps or kerosene etc.. Hot water and dish detergent can also be utilized for brush cleaning.

Summary of Key Points:

- Protect bore after returning from field until you have time to clean.
- If shooting suppressed rifle, remove carbon as first step using bronze brush and solvent.
- Remove copper, swab bore with solvent with either bronze brush or white poly pad (nylon brush also useful on light foulers).
- Soak and swab method.
- Check patch colour or muzzle.
- Soak and swab again if necessary.
- Neutralize and remove solvents before throat polishing.

Step 4 - Bore polishing routine

I want to get straight to the crux of the matter here and the best way for me to get the message across to you is to say this: If you do not keep the throat of your rifle polished, it may begin to show the first signs of wear at the 250 round mark. By wear, I mean heat cracking, also called fire or craze cracking.

Throat wear showing typical heat cracks at high magnification. Note the deep crack at 2 o'clock.

Hopefully the 250 round figure really drives home the importance of throat care. Sometimes a shooter will begin to kill the throat of his rifle during load development, if things aren't going well and he gets into a frantic situation of continually loading and test shooting without paying attention to maintenance. The same goes for the plinker and target shooter alike. Target and long range shooters can be even more at risk

because they can become so paranoid about losing established accuracy, as to be nervous and too light handed in their approach to maintenance.

If we are to preserve the bore for long term accuracy, we need to keep the pores of the steel closed. The common misperception amongst shooters is that because the throat is steadily being worn via friction (shooting) further deliberate abrasion seems completely absurd. But I can assure you, the opposite is true. This is a paradoxical situation, and it is important to understand that by polishing the throat and keeping the pores of the steel closed we can keep cracking and general throat wear to a minimum - and thereby maximize throat life.

Generally I polish the throat of my rifles, using Autosol paste on a 4x2 cloth after every shooting session. The first step, as previously described, is to remove copper and expose the bare steel of the throat. Then I commence polishing.

Rolling a 4x2 patch in Autosol.

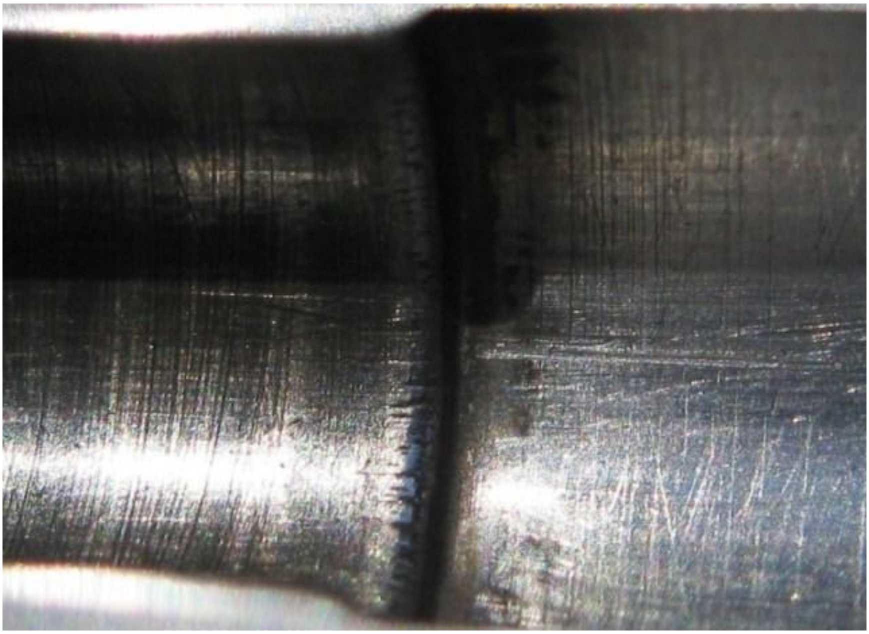
Sometimes I get the urge to simply fire a shot at my 750 yard gong on an evening after work which means firing one fouler and one shot, then home. On these days, I simply clean the bore after my two shots without polishing. But if I am engaged in a full shooting session, I will polish the throat once I arrive home.

I use a maroon poly pad roughly once per 100 shots, knowing that if I leave it for 250 rounds, craze cracks may begin to appear. I apply the delaminated poly pad to a worn bristle brush, looking for a tight fit. I give the throat roughly ten strokes (twenty back and forwards). I concentrate on the throat only, my stroke being roughly three inches in length (not that the throat is this long!). This ensures that I am not opening the bore dimensions further into the bore - muzzle tight is the key. Once the pad is worn down from throat polishing, I will then give the full extent of the bore a quick polish.

The next step is to give the bore a light polish with paste on a 4x2 patch, again focusing on the throat before polishing the extent of the bore. A clean rag with brake cleaner or meths will remove most black polishing residues, a second dry rag will remove final residues. Personally I do not chase final cleaning to the extreme. There is no need to continually pass clean rags through the bore.

Rifle laid flat on my workbench, a rag under the scope.

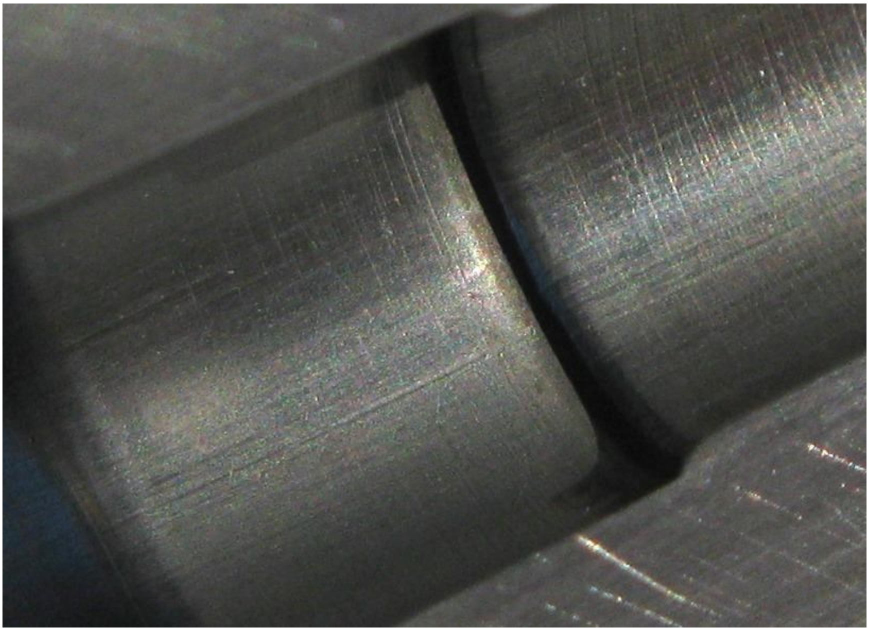
After many years of using this method to care for both my own rifles and client rifles I have found this approach to be very sound. If you are extremely timid about the long term use of a maroon poly pad, you may wish to adopt the very fine grey poly pad; but please understand that the maroon grade works very well and will not cause undue harm to the throat or bore. I would also advise against using the grey pad throughout the bore as this may eventually lift the finish too far. If using a fine grey pad, stick to the throat with limited passes through the extent of the bore.



Gas erosion in the neck area of a 7mm RUM barrel.

Some of you may find that as hard as you try to remove copper from the bore prior to polishing, some stubborn copper remains. If your bore tends to behave in this manner, then it will benefit greatly from occasional cleaning with a maroon poly pad after fully defouling with a solvent and brinze brush. Again, I would suggest doing this at around the 100 round count.

If your rifle is a very stubborn fouler, you may wish to try and lift the overall finish a touch after using the maroon poly pad by following



The same chamber after polishing.

through with either a grey poly pad and or a white poly pad and paste; the latter two pads with paste have a more aggressive polishing action than paste on a soft rag. But again, we need to be very careful regarding bore finish versus bore dimensions. If your rifle is extremely accurate, you need to consider the fact that the heavy fouling may be aiding accuracy - even if accuracy wanes after 20 shots. In some ways this can be a juggling act. Fortunately, you will not ruin the accuracy of your rifle in one polishing section - allowing room for experimentation. An important factor, considering each bore needs to be treated on an individual basis. Let common sense be your guide along with very careful observation.

The opposite extreme is the highly polished bore that produces very little fouling. We have to be a bit careful here, as we don't want to lift the finish any further. The trick here is to focus on the throat only, keep your throat polishing strokes short and as soon as you are done, swab the bore with brake cleaner to remove polishing paste residues before re-applying lube.

During cleaning and polishing routines, you may also wish to inspect the throat as the bore ages. Those who own a bore scope will find this task relatively straight forwards. It is certainly much harder to study the throat without this tool but it is possible to make basic observations with the naked eye. By looking into the bore (chamber end) with the rifle held slightly off center and towards daylight, the beginning of each rifling land can be seen. If the bore is in optimum condition, the start of each land should appear somewhat similar to a well sharpened chisel, the taper being very distinct. As the throat wears, this taper will gradually become shallower and gain length. In very worn bores, the beginning of each land will be near indistinguishable and will have a very long taper. The lands may also have a fuzzy grey colored appearance if the throat has not been kept polished. These are basic indications of throat wear and if these conditions are observed along with a drop in accuracy, the bore may soon need replacing. In many instances, it is possible to set about fresh experiments with hand loads, altering bullet seating depths and powder charges to gain increased barrel life. Nevertheless, a point will be reached where the bore can no longer produce desirable accuracy.

From time to time it also pays to inspect the muzzle of your rifle with a magnifying glass, particularly if your bore is chrome moly. Any rust pitting or corrosion based degradation of the edges of the lands will indicate a need to either dock the muzzle or rebarrel. Pay particular attention to the intersection of the lands and grooves which are easily overlooked. Although we generally associate rust as being orange in

color, after bore scrubbing, the color will be removed, necessitating closer inspection in order to see damage. Rust pitting and corrosion of the edges of the lands will appear grey in color- but is not to be confused with carbon fouling. If water has entered the muzzle during shooting, this may also immediately damage the muzzle through hydraulic pressures. An obvious indicator is a bulge or what appears to be a swage mark on the outer barrel near the muzzle. However, sometimes there is no obvious bulge - the rifle having shot well prior to a wet weather hunt but shooting poorly thereafter - without any corrosion evident.

Once you have given the throat and/or bore a polish and completed inspections, the next step is bore preservation.

Summary of Key Points:

- Lightly polish throat (4x2 rag and paste) after each shooting session (no need if only 1-2 shots fired).
- Polish throat with poly pads, followed by rag and paste at 100 round count.
- Full bore polish occasionally.
- Treat each bore individually.
- Inspect the muzzle (closely) periodically.
- Inspect the throat periodically.

Slow fouling bore care

If your rifle is a slow fouler, you will need to take special precautions with regards to cleaning regimes in order to avoid high round count fouling sessions.

Both carbon and copper fouling are to be considered precious in the slow fouling bore so we need to try and preserve this layer for as long as possible - but not at the expense of the bore.

Following shooting sessions and during periods or seasons when the rifle is undergoing regular use, we need to avoid using solvents, instead utilizing such products as CRC Long Life (CRC SP-350) to clean away powder residues and provide immediate rust protection prior to short or medium term storage. Long term storage (rust prevention) of the rifle consists of the same preservatives and methods suggested in the text ahead.

The big question with a slow fouler, is when to fully de-foul and polish the throat to prevent craze cracking (remember all of that heat goes somewhere). This is something that you will have to determine for yourself. You may choose to perform a full cleaning and throat polishing session after 100 rounds or perhaps 200 rounds. For this to happen in an orderly manner, you will need to stow projectiles or ammunition in such a way that you are alerted when it comes time to clean the barrel. If for example you purchase projectiles in bulk, you may wish to stow 200 projectiles in a container so that once the container is empty, you know it is time for a full break down and cleaning session. Visual inspection of the muzzle (after swabbing with CRC Long Life) can also be an aid, monitoring the gradual buildup of copper.

One problem with the slow fouler is that we won't know when accuracy is going to fall off until it does. Is accuracy going to fall off at 100 rounds or 200 rounds? You will never know until it happens and all that you can do is keep shooting until you find the limit for your individual bore. Hopefully, the rifle will open up from group sizes of under .5 MOA to group sizes of around .75 MOA rather than throwing fliers several inches away.

After cleaning and polishing you will need to work out a best practice with regards to re-fouling. You may for example, wish to utilize downloads with Trail Boss powder and a very soft projectile to both re-foul the bore and fire form newly introduced brass. On the other hand, the rifle may require full power loads to re-foul. Still, this can be changed from a chore to an opportunity by using such sessions as a chance to practice standing snap shots at short ranges and so forth.

If you completely avoid strip cleaning and polishing regimes in the slow fouling bore, the long term results can unfortunately be disastrous. I have seen instances where the preservative oil used during storage was not thick enough and carbon continued to attract moisture over a long period of time. While the bore looks good during visual inspections, corrosion sets in beneath the carbon layer. Eventually, the rifle that never needed cleaning loses accuracy but it is now too late. Once fully stripped of copper and carbon, the bare steel shows severe pitting and excessive throat wear. This damage cannot be rectified with polishing or re-fouling. To this end, even if the rifle is not used a great deal, I would suggest a full cleaning and or polishing session between seasons or year to year basis.

Summary of Key Points:

- Avoid harsh solvents in the slow fouling bore while the rifle is in regular use.
- Determine a dedicated cleaning regime based on round count or accuracy degradation.
- Be aware of potential corrosion under carbon as well as eventual throat wear.

Step 5 – Storage & rust prevention of the bore

Bore preservation is so very important, yet often overlooked. A swab with light oil prior to storage can be the very worst way to care for a rifle, the oil eventually dispersing leaving the bare steel of the bore exposed to the elements. In contrast to this we are confronted with many light oils which are supposedly ideal for storage.

Over the past century we have really lost our way when it comes to bore and general rifle metal work preservation. To fully understand our folly we need to wind back the clock.

You will have already read about my liking for grease as a rust preventative in earlier sections of this book. However, when I embarked on writing this book, I felt a bit alone in my usage of grease over the years. It seemed that nobody used grease anymore, so I thought I had better do some serious research on the subject. The results of this research were very surprising.

There was a time when grease was the norm. In fact, grease was often (depending on nation) issued to soldiers in small tins. Lanolin was a common base for gun grease (and recently has made a return), but was eventually replaced with lithium grease. In some instances grease was used to protect metal work, excluding the bore (possibly due to the expectation of regular range work). In other instances grease was also used within the bore. With time, these cleaning methods evolved depending on the doctrine of each military. My British ancestors for example used Youngs Wool Fat Jelly - wool fat referring to lanolin grease. This was used for gun storage, and many of you will be familiar with the comment: “I came across a collector who had an SMLE still in its grease”. So here we see a simple example of grease in use that many of us are familiar with, but mentally we tend to allocate this to new unpackaged rifles. That’s because these rifles were employed in regular

drill once they were uncrated; the soldier or cadet being reliant on Youngs 303 oil for mid-term storage.

The U.S military used gun oil, grease, and Cosmoline. Gun oil and/or grease could be used within the bore for storage. But like the British, once a rifle was uncrated it was put to regular (weekly) use and daily inspections, lowering the need for grease within the bore. Cosmoline was ideal for long term storage, setting very hard and wax like - ideal for rust prevention of crated rifles and for rust prevention of all military equipment, including ships' guns when crossing the Atlantic.

As far as I have been able to ascertain, the German military were the exception and did not use grease to the same extent as other nations, relying on Ballistol oil as their all-round elixir. No doubt grease was used by the German military - my point here is to simply convey a general attitude.

But in the world of gun cleaning the Swiss were the masters. Following range work, the bore of the infantry rifle while still hot was swabbed with Waffenfett (gun fat), a fairly basic lithium grease (perhaps lanolin based in earlier times). Once the soldier or reserve returned to his barracks or his home, he could then commence a thorough cleaning session. Furthermore, if for some unknown reason the reserve did not complete this task in a timely fashion, the bore could be left to sit for days, weeks or months without any risk of bore corrosion. Waffenfett was also used on outer metal work, it was used everywhere. The small military issue tins of Waffenfett are now a collector's item. However, Sauer (Germany) continue to produce this product as an all-round gun preservative.

So, somehow we forgot the benefits of grease. Some of this may be as a result of the perception that grease is a "new rifle" thing, not realizing that a new rifle is simply a rifle in storage. Another factor is that modern gun companies are quite paranoid about litigation, promoting thin oils

that pose little risk of causing a barrel bulge or rupture through hydraulic forces. Yet another factor is the advent of stainless steel barrels, lessening the need for heavy protective coatings on polished bore surfaces (although we often neglect outer surfaces!). In the preliminary rifle setup section I also mentioned that grease may not be ideal for desert conditions, particularly where dust storms drive sand into firearms parts. Having said this, thousands upon thousands of our ancestors fought in desert conditions and never once complained about grease. They complained about the desert, but not the tools they used to clean and maintain their rifles. So, while I have mentioned thin dry film lubricants and protective coatings, try to keep things in perspective. Use products that offer optimum protection without sacrificing any one factor for another.

I remember my grandfather talking to me about the hopelessness (effective range) of a submachine gun in North Africa and the need for a well tuned SMLE capable of engaging the enemy at extended ranges. I wish he was here now, so that we could chat about rifle care in order to gain a greater insight into how things were done versus how we do things today.

While there are many factors that have changed our view on grease as a protective coating, none of these factors have enough validity to warrant the permanent exclusion of grease from our essential cleaning kit, especially now that user friendly lanolin greases are back in circulation. I therefore highly recommend that you obtain a tube or tub of grease as an essential item. How you employ grease will depend on the rifle and usage. Type of steel and time are the key factors we need to consider regarding bore preservation. A stainless bore with food grade finish needs only light film protection. A chrome moly bore needs heavier or stronger coatings and if the bore is to be stored long term (between seasons), the coating needs to be up to this task.

Some of my current favorite products: CRC Long Life (CRC SP-350), CRC Brakleen, CRC Soft Seal (CRC SP-400), Lanocote (lanolin based grease), and a jar of synthetic motor oil.

New products such as CRC Soft Seal produce a semi solid barrier, ideal for long term storage. Soft seal is much like Cosmoline and is held to military specifications (mil spec).

With this background in mind, we can now move on to the practices of barrel care.

Stainless

I generally use a simple coating of CRC Long Life on stainless bores. Light oils such as Rem oil or Ballistol are equally good and easily removed. There is little chance of making a mistake here - a simple case of swab back and forth and walk away. If you intend to leave your rifle stored for over one year in coastal conditions, you may wish to use grease for

storage (application discussed further ahead in the chrome moly long term storage section).

Chrome moly - regular usage

If using a chrome moly bore on a regular (weekly) basis, a light gun oil such as Ballistol is sufficient. CRC Long Life is also very useful for such purposes and is designed to preserve engine parts during rest periods without need of any heavy cleanup operations upon start up.

A modern high end dry film bonding lubricant such as Fluna Tech can prove extremely effective. We can also add Youngs gun oil to our list here, Youngs being very good due to its rather heavy viscosity.

Whichever protective coating you use, check the rifle regularly to make sure that the product is working. You may also wish to employ the lube on outer metal work for a period, as a way to provide a surface area for observation. I have been caught out with fine protective coatings in the past, thinking that the light film would work as advertised, only to find that surface rust set in fairly quickly. To avoid this, I have used both synthetic motor oil and diff oil as heavy viscosity protective coatings. The downside of motor oil is that it can run, migrating away from where it is most needed. Nevertheless, I have had very good results over the years, using motor oil for short term storage. Ultimately, if you have any doubt as to when you will next use the rifle, employ grease!

I use a 4x2 patch and rod to apply protective bore coatings, paying attention to the bore, then spiraling the patch around the chamber to prevent corrosion in this area. If the protective coating is aerosol borne, I spray the 4x2 patch. If you wish to also apply aerosol directly into the muzzle of your rifle, that is entirely up to you. I also grease the muzzle of my blued rifles when taking care of the outer metal work.

Careful removal of heavy oil or grease from both the barrel and chamber prior to shooting is very important! And herein lies the

problem for gun oil makers. If they make the oil too heavy and the customer does not remove it properly prior to shooting, he may bulge or rupture the bore. A thin oil saves litigation, and this I believe is why gun oil makers utilize very thin oils. Obviously mistakes are easily avoided, as long as you have set the proper procedures in place. I treat all of my bores as being unusable, as they sit in the lock up. I have it cemented in my mind that I cannot use my blued barreled rifles, unless they are thoroughly cleaned and prepped for the field.

Following storage, oils or grease can be broken down and removed with brake cleaner, Hoppe's No.9, Kerosene, petrol, meths, or turps - the list goes on. Once the protective coating is removed from the bore and chamber, I check the bore with a dry patch, then re-apply a field lube onto the same patch. It sounds long winded, but is a very simple process once you have the system in place.

Chrome Moly - long term storage

My definition of long term is not knowing when you might use your rifle again. If the rifle is your pet, no doubt you will want to use or handle the rifle on a regular basis - whispering sweet nothings into its chamber. But wherever there lies a question mark, as to when the rifle will be next used, adopt grease as a long term storage procedure - even if the rifle by chance ends up being used within a short period of storage. The major downside of oil as a protective coating is that over time oil migrates away from where it is needed.

To apply grease use a one piece rod and 4x2 cloth. The one weakness of grease is that it does not migrate so the key here is to apply heavy coatings, repeating the process until the bore is thoroughly coated and protected. Using clean hands (no salt residues), smear grease onto the 4x2 cloth, then swab the bore back and forth. Following this, remove the rod and observe the 4x2 cloth. You will note that the cloth now has a very low level of residual grease, signaling the need for reapplication. I

find that repeating this process three times ensures that the bore is thoroughly coated in grease. Once you are happy, swirl the swab around the chamber to ensure that this area is fully protected, then apply a heavy dab of grease across the muzzle.

At this point I wish to relate a sad story. Last night a man came to visit carrying an early number VZ 33 rifle. It belonged to his father, but after his father retired from shooting the rifle was put into the gun lock where it sat for 20 years. I looked the rifle over - it would have been beautiful once. I could see that the action had been polished and given a deep blue, something that could only be done during the interwar years when gun makers had the time to pay attention to finer details. Nevertheless, the blue was intermittent, the majority of the rifle covered in heavy rust. The bore looked like it contained gravel - yet I am guessing it was probably oiled before it was put into storage. Careful inspection showed that the bore probably saw very little actual use and that its only downfall was heavy corrosion. As far as I am aware there were only 25,300 VZ 33 rifles ever made. Just imagine what a wonderful find this could have been, if it had been stored with grease.

Lithium grease is generally available in long tubes, tubs or tins for automotive, industrial, and marine applications. Marine grade grease has obvious merit due to an emphasis on corrosion prevention. Tube packed grease should be removed from its tube and placed in shallow jars or tubs for ease of handling when working on firearms. Generally speaking grease in a tub or tin is much easier to work with, CRC Marine being an ideal example. Lanolin based grease is also starting to re-appear as an eco-friendly alternative to lithium grease. A major advantage of this grease is that it cannot harm synthetic materials, including epoxy resin bedding. Once again, CRC get a plug here for their LanoCote grease, available in both aerosol and tub packaging. LanoCote is about as good as it gets for rifle care: a safe, completely harmless natural grease which boasts excellent long term protection.

Grease loaded onto a 4x2 patch. I like to re-apply grease to the patch after swabbing the bore, then repeat the process again for a third time, ensuring that the bore is fully coated in grease.

Although I wish to avoid brands, there is one more CRC product which I feel deserves special mention - CRC Soft Seal. This aerosol borne product sets firm and wax like after application and is a dedicated heavy duty corrosion inhibitor. It can be removed from the bore using brake cleaner or turpentine along with Hoppe's No.9, but requires a little more work and attention to detail than grease removal. Like LanoCote, Soft Seal is ideal for long term storage and perhaps the very best product for storing and preserving vintage rifles.

After storage, the bore will once again need to be degreased prior to preparing it for field work. Along with the bore, it is extremely

important that you remove heavy adhesive lubricant from the chamber following storage. If you do not thoroughly clean your chamber, you may cause a barrel or action rupture through the hydraulic forces exerted within the bore. Again we see gun companies trying to avoid accidents and subsequent litigation by using thin oils.

To clean the chamber, apply solvent on a 4x2 swab and spiral the swab around the chamber. There are also dedicated chamber cleaning jags you may wish to use with your one piece rod, but please make sure that the chamber is wiped clean with a cloth patch.

If you have used CRC Soft Seal or a similar dedicated corrosion inhibitor which has hardened over time, it is important that you utilize a solvent capable of breaking up the hardened product. Hoppe's No.9 is an excellent solvent for such purposes, working extremely well - left to soak for a period of time followed by cleaning with brake cleaner spray.

This concludes our bore maintenance section: From preparation of the bore for field use, to cleaning, then polishing, followed by rust protection. This section of the book may seem long winded and overly complex, much of this is due to the digression into lubricants, protective coatings, and brands. Nevertheless, once you have basic procedures in place, you will find bore maintenance relatively straight forwards.

Summary of Key Points:

- For regular weekly usage- use light to mid weight lubes.
- Stainless generally easy care.
- If there is any doubt about length of chrome moly barrel storage, use grease or similar adhesive protective coating.
- Long term storage of chrome moly, use grease or adhesive protective coating.
- Make sure both chamber and barrel are thoroughly degreased after storage, prior to shooting.

Chrome lined bores

Very few modern bolt action rifles have chrome lined bores and for the most part, the discussion of chrome lined bores is moot in a book on long range bolt action rifle accurizing. Nevertheless, I believe it is important to cover this topic as readers will want to know how my barrel break in and maintenance methods sit with chrome lined bores. Those who are interested in AR-10 and AR-15 accuracy will be especially interested.

Chrome plating the bore or chamber of a rifle is utilized for two purposes - to protect the bore from corrosion and also to protect the throat of the rifle from erosion.

Hard chrome plating has been used in the arms industry for decades. One of the earliest documents I have been able to find on this subject concerns a patent application submitted by John M Olin (Western Cartridge Company) in 1927. Olin wished to utilize chrome plating for the purpose of protecting rifle barrels and for the purpose of restoring older firearms. Where this lead to, I do not know. In military arms, the

use of hard chrome plating appears to have been initially utilized by the Japanese as a means to increase the strength of the type 99 Arisaka 7.7mm rifle. It is my understanding that the Japanese were forced to pursue this course of action in lieu of suitably strong steels during this time period due to U.S trade sanctions. In this case, corrosion and erosion protection were secondary benefits of the plating process.

Following the Second World War, chrome plating military arms (small and large) came into more widespread use as a means to prevent both erosion and corrosion, therefore extending the life of the weapon. One can see how this would be especially useful for naval weaponry seeing that navies of the world operate in extremely corrosive environments.

Regarding small arms, many readers will be familiar with the chrome lined SKS and AK-47 rifles (with the exception of pre 1970's Yugoslavian rifles) of old through to the M16 and AR-15 rifles which generally feature chrome lined bores. The Russian SVD sniper rifle is also chrome lined.

The chrome lining of the M16 rifle came about after a period of dire problems with the M16 rifle jamming in the field (Vietnam War). At the time, jams were blamed on dirty chambers leading to extraction difficulties. The initial fix involved chrome plating the rifle chambers in an effort to smooth out the steel and prevent corrosion. This eventually evolved into chrome plating of both the chamber and bore. Sadly, it was a long time before the primary cause of extraction difficulties was found - mistiming. In essence, due to a change in powders during its inception, the M16 action suffered mistimed extraction and tried to cycle while the case was still expanded to the chamber walls. Regardless of whether chrome plating aided in overcoming this problem, chrome plating provided a measure of erosion and corrosion resistance and has remained in use to this day.

Although the practice of chrome plating is most common within military rifle production, it is also prevalent within the manufacture of civilian arms such as the chrome plating of shotgun bores. Chrome plated bores also appear on bolt action rifles from time to time.

To chrome plate a bore, the bore must initially be made with slightly loose tolerances or more typically electro polished to ever so slightly increase the bore and chamber diameter. Bear in mind that the plating is ultra-thin. The chamber must also be cut at the same time as the bore, so that the entire inner barrel can be chrome plated. Hard chrome plating is not the same as bumper or tap chrome plating which utilizes an intermediate layer of copper. In a chrome lined rifle barrel, the chrome is chemically etched / welded directly onto the bore.

Chrome plating has limitations as military researchers are well aware. High chamber and throat temperatures do lead to cracking of the chrome layer which in an assault rifle, may consist of a layer less than .0005” (a half of a thou) in thickness. Cracking occurs because the chrome layer is not as elastic as the barrel steel during heating and cooling. Having said this, the barrel steel also suffers from the heat of ignition. Once cracks form in the chrome layer, this heat based erosion continues into the parent barrel steel (as it would without chrome plating). Common sense dictates that chrome can be used to extend the life of a barrel but that it is not a miracle fix.

Somehow we have to put all of this information into context.

To begin with, if a bore and chamber have been electro polished, there will be no sharp edges or burrs remaining. The mirror like layer of chrome plating further enhances the already smooth steel surface, nullifying the need for our standard barrel break in procedures. What you see is pretty much what you get.

If we try to lap the bore with poly pads, this process will have no effect on the chrome plating. The chrome surface is simply too hard for the poly pad to cut and polish.

Test:

Take a poly pad, go to your laundry and attempt to polish a chrome tap fitting. What happened? Did the poly pad leave any marks in the chrome surface at all?

Again, what you see is what you get. To this end, all we can really do is focus on maintenance procedures for the chrome lined bore. We can monitor fouling; whether that be copper or carbon buildup and how accuracy is affected. Does the bore produce any copper fouling whatsoever? Does the bore in question need a good deal of carbon or copper fouling to shoot straight? Or does the bore shoot best when relatively clean. As for protective coatings, there is no need to utilize heavy protective coatings in a chrome lined bore, provided the plating at the throat is still intact and the rifle is not being stowed away for a very long period of time in potentially corrosive environments.

As the throat of the chrome lined bore wears down, it can be best to utilize the throat polishing methods as outlined in this book in order to try and keep the pores of the parent barrel steel closed. If you shoot fast strings or use tracer ammunition in your AR, you will need to think seriously about long term throat maintenance. Going back to our poly pad test; if the throat plating is intact, polishing will have no impact. There are no potentially negative consequences for those who are timid about such things. If the throat plating is worn, polishing will help maximize barrel life.

With regards to corrosion, I have seen fully rusted out barrels that were initially chrome plated; though it took a good measure of time, harsh environmental conditions and extremely poor maintenance for this to

occur. In contrast to this, I have seen well-meaning assault rifle authorities state that they have fired 3000-4000 rounds of ammo without ever having cleaned their rifles, claiming that the AR-15 / M4 rifles do not need to be cleaned, period. That might be OK in certain locations (and high praise for the current AR platform), but try that in a harsh corrosive environment. Such a test also has no bearing on rifle accuracy, its primary concern being reliability. For those of us concerned with rifle accuracy, tests of this nature do not allow us to see the entire picture.

The muzzle of a combat rifle is another area of concern. Carbon attracts moisture and in turn can cause corrosion and or delamination at the muzzle of a rifle. The speed or rate of this corrosion depends on the severity of environmental conditions. The smallest upset to the muzzle will dramatically effect and ruin accuracy. If the muzzle has a brake which has been thread locked in place, it is impossible to remove caked carbon from the entire face of the muzzle. Nevertheless, it is possible to break down carbon where the muzzle intersects the bore, utilizing a solvent such as KG 1 in conjunction with a cleaning rod and bronze brush pushed through and out of the bore, then carefully pulled back into the bore. Following this, the bore and muzzle can be neutralized with a rod, rag and degreaser such as brake cleaner. Push the rag through the bore, then as the rag partially exits the muzzle, pull it back slightly and spiral the rod, allowing it to clean and neutralize solvents at the muzzle. Follow on from this with a dry patch. For preservation, use CRC Long Life (CRC SP-350) to swab the bore and again, allow the rag to partially exit the muzzle, then pull it back slightly and spiral the rod to wet the muzzle. After this, pass another wetted rag through the bore again to ensure you have not pulled any carbon or debris back onto the bore. This will at the very least help prevent corrosion of the muzzle and help ensure that the throat which may or may not have its plating intact, remains protected.

If you wish to retain the carbon layer within the bore for reasons of accuracy, you can omit the bronze brush and solvent step and simply focus on bore preservation, utilizing CRC Long Life or your preferred protective coating to swab the bore and wet the muzzle.

In plain terms; use your common sense. There really is no excuse for an avoidance of gun maintenance. If you love your tools, you'll look after them. A chrome lined bore is ideal for combat, resisting corrosion over long periods of time when there is little chance to clean the rifle, while also boasting lower copper fouling than traditional arms. But that does not mean that we should treat such a tool with utter contempt.

The same goes for the gas system of the AR. Most authorities (including the U.S Army) state to leave the AR gas tube alone. This advice is given in order to avoid any risk of blockages as a result of human error or extremely heavy carbon deposits as a result of oil / lube deposits igniting within the gas tube. It is instead recommended that the gas tube be replaced when necessary. Yet again, common sense should dictate your approach to such matters. Older M16 rifles were made using carbon steel gas tubes, modern rifles utilize stainless steel tubes (exterior often painted). If the rifle takes a good dunking or is put through hell in some similar manner - the gas tube may well need cleaning. If solvents leak into the gas tube during barrel cleaning, this may also need to be addressed. You do not need to be told what to do in this regard. As always, treat matters of the rifle on an individual basis. If you need to scrub the gas tube of your AR, there are specialized tools for this such as the Midwest Industries gas tube cleaning brush.

Happy hunters aboard an NZ Army NZLAV III. Note the protective tape on the M242 Bushmaster 25mm automatic canon.

With regards to extreme accuracy, chrome plating can have the undesirable trait of being deposited unevenly. Another problem is excess buildup at the intersection of the lands and grooves. Very recent practices tend to minimize such problems and there are also methods to help maximize accuracy, such as gradually drawing the barrel out of the bath, chamber first. This results in a heavier coating towards the muzzle, making the rifle muzzle tight. It is possible to make an accurate chrome lined bore with great care and cost but not so easy to mass produce the same for an over eager market. To this end, those seeking extreme accuracy from AR-15 rifles are better off utilizing barrels built specifically for match accuracy. Stag Arms for example produce what may best be described as general purpose barrels featuring chrome lined bores while their most accurate barrels are made from stainless steel. These barrels are built and lapped to optimal tolerances.

Going back to the lapping basics described in this book, you will note that I have suggested that if a bore is smooth and produces low copper fouling, it needs to be dimensionally uniform or slightly muzzle tight in order to produce optimal bullet stability and therefore optimal accuracy. Following on from this, it should be no great leap for the reader to see how an ultra-slick chrome lined bore can present problems if the bore is not uniform or muzzle tight in tolerances. One barrel may shoot extremely well while another may shoot poorly based solely on these principles without any other factors added to the mix.

It is possible to fire lap a chrome lined bore to enhance dimensions - but it should be obvious that the thin chrome plating will be compromised by such practices. Such factors need to be taken into consideration before any experimentation of this nature.

Summary of Key Points:

- A very fine layer of chrome plating is used to prevent both rifle barrel erosion (throat) and corrosion.
- What you see is what you get - a chrome plated bore and chamber are for the most part field ready and without need of break in procedures.
- Accuracy from rifle to rifle is dependent on individual bore and plating tolerances.
- Utilize basic cleaning and maintenance produces. Set procedures on an individual basis. Look at your situation and study your rifle - not what everybody else is doing.
- Use your common sense. Highly corrosive environments demand greater rifle care.
- Watch for eventual throat wear and pay attention to the

muzzle of your rifle.

Bolt maintenance

Before we begin this section, please be aware that when handling springs, there is a potential risk of eye injury - especially with bolt shrouds which can separate from the bolt body at high velocities. During full bolt disassembly or any spring handling operations, please wear safety glasses. If compressing springs, please utilize the help of a second person also wearing safety glasses.

Bolt maintenance is yet another commonly overlooked task. If the bolt assembly of your rifle is corroded, the rifle may produce inconsistent ignition which will obviously result in either poor accuracy or a high ES. If the bolt internals are gummed with grease or grime, the rifle may produce poor ignition in sub-zero conditions and may not fire at all.

The best way for me to drive home the importance of bolt maintenance is to use a recent example. A client sent me a stainless .300 RUM M700 rifle fitted with a suppressor. The barrel was 800 rounds old, the rifle only a few years old. Somehow, the trapped gases managed to make their way back to the bolt face and then entered the bolt body. In the past I have generally only seen a carbon buildup at the case neck area of the chamber of suppressed rifles. But in this instance, when I disassembled the bolt, the stainless firing pin (striker) body was beginning to show signs of corrosion. I managed to cleanup the corrosion, still being aware that I might have to obtain a new firing pin. After reassembly the rifle managed to shoot one hole groups with consistency. Fortunately, there are readily available aftermarket M700 firing pins, the same cannot be said of other brands. While we are on the subject of M700 firing pins, I have never been one to get into the

lightened aftermarket M700 firing pins which are promoted as offering potentially increased accuracy. The above rifle being a case in point, this rifle is still putting three shots into less than .2 MOA. Nevertheless, this and strong aftermarket mainsprings are something we should keep in mind for problematic rifles suffering such problems as a high ES. I have had to replace two mainsprings over the last few years.

Going back a few more months: I was sent a Winchester M70 - the internal bolt body, mainspring, and firing pin along with the safety mechanism were rusting. From the outside the bolt looked fine, internally it was very sad. Fortunately the parts cleaned up well.

Had either of the above rifles been left any longer, the results could have been worse. I might have been able to find replacement parts. But as I have said, depending on the brand and model of rifle, replacement parts' availability cannot always be guaranteed.

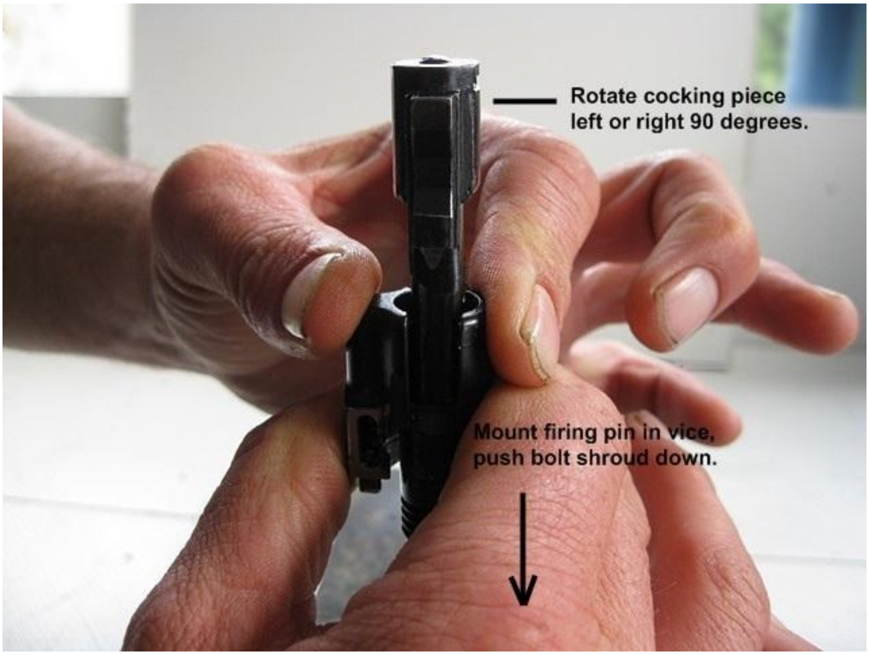
It is best to check your bolt internals at least once per year. If you have been hunting in inclement weather, you will of course need to check the bolt over sooner. If you are a military or police operator, you will need to perform more regular checks.

The first step is to learn how to disassemble your bolt. Generally speaking, bolt dis-assembly information can be found in user manuals, whether obtained with a new rifle or obtained via the internet. In lieu of this information the trick is to know how to lock the mainspring (firing pin spring) in place, so that the firing pin and mainspring assembly can be removed in a safe and controlled manner.

Rifles of the Mauser design ilk are the easiest to deal with. The safety can be set to the middle position (rifle cocked on empty chamber), the bolt can then be removed from the rifle action, and the bolt stripped by simply unwinding the bolt shroud counter clockwise.

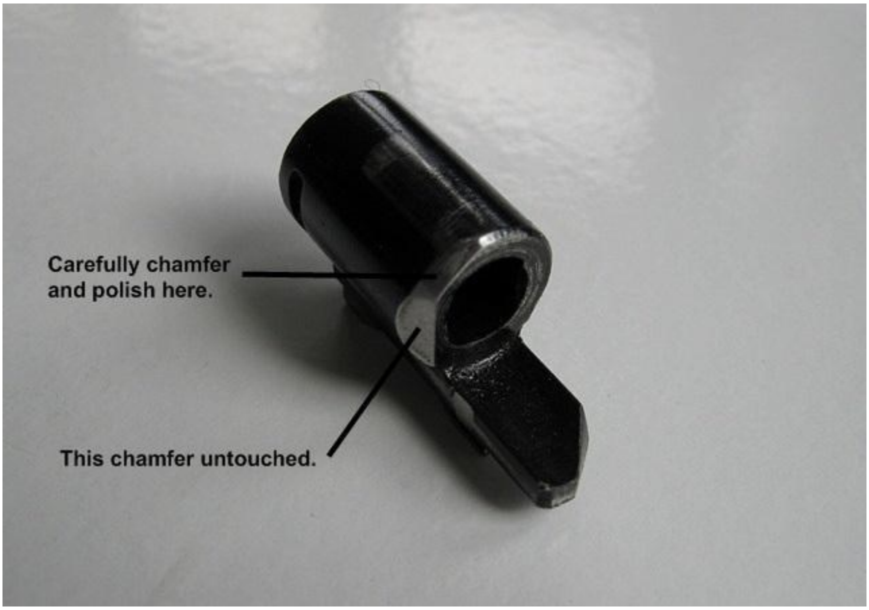
Basic dis-assembly of a Mauser bolt. This is an excellent bolt design.

*If your scope prevents you from using the Mauser safety mechanism, place the cocking piece (sear) against a sturdy wood bench and pull the bolt body down. This will allow you to engage the safety. **Make sure you are wearing safety glasses!***



The Mauser firing pin is well designed for dis-assembly, featuring flats which can be held securely in a vice. Once secured, the bolt shroud can be pushed down, the cocking piece turned to release it from its keyway. Following this, slowly lift the bolt shroud to release the mainspring. This part of the job is best performed with the help of a second person, both of you wearing safety glasses.

Mauser bolt, almost fully stripped.



The safety on this Mauser was not working, the flag unable to cam over (as can happen on Win M70). With careful honing and testing, the safety was made operable.

The M700 is a little more difficult and there are several rifle designs which utilize a similar style bolt assembly with no way to lock the mainspring in place. There is a special tool available for the M700 which I am sure most M700 shooters do not own, therefore I will offer an alternative. Take a piece of inner tube and lay it over the bolt shroud as shown in the following picture. Next, take a set of polygrips and place one jaw of the polygrips against the cocking piece sear, the other against the bolt shroud,and then compress the two parts ever so slightly. Holding the sear and bolt shroud in this position, unscrew the bolt body to reveal the firing pin and mainspring.

Disassembling an M700 bolt. Make sure your vice grips are set wide otherwise the force applied will be at an incorrect angle, creating a great amount of difficulty compressing the mainspring. Dis-assembly should feel 'easy'. Once disassembled, removal of the mainspring from the firing pin (if ever required) is a little more difficult than the Mauser. In this instance, the bolt shroud is pulled down and the mainspring compressed to reveal a cross pin through the cocking piece.

M700 bolt stripped for basic cleaning.

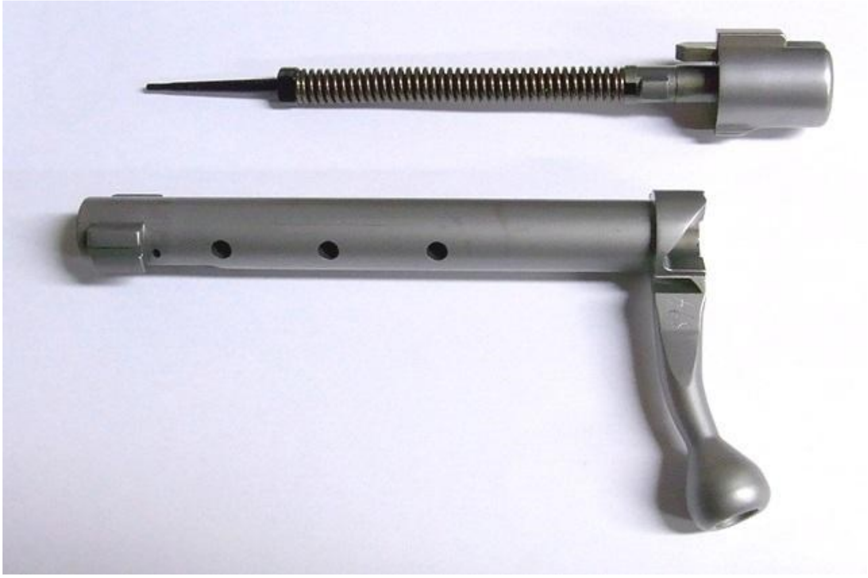
Ruger have a nifty setup for the M77. The bolt shroud can be rotated a half turn clockwise. A hole at the back of the cocking piece is provided so that a pin, nail or allen key etc. of a close fit diameter can be passed through the hole. The bolt shroud can then be turned counter clockwise to reveal the firing pin and mainspring.

A Ruger M77 bolt, the pin hole at the bottom rear is obvious. Once this is pinned, the bolt can be stripped with ease.

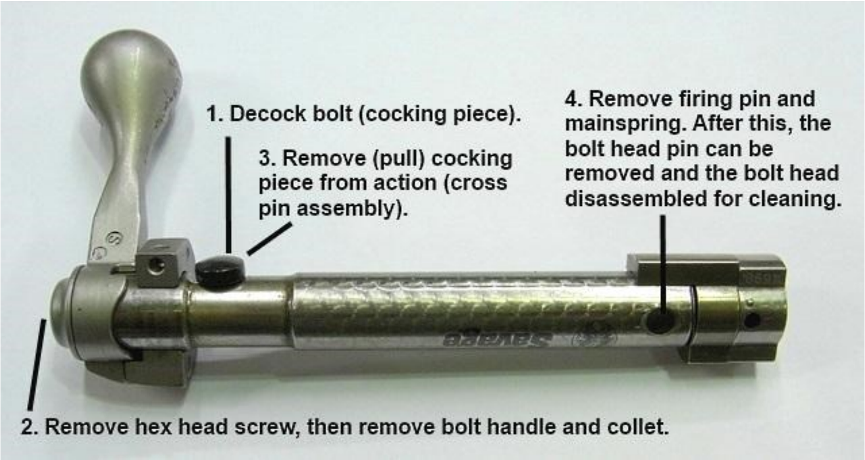
Tikka rifles have a plastic bolt shroud. This is simply removed by turning the shroud a half turn clockwise which releases the shroud itself from the bolt. Again, a pin or allen key etc. can be inserted into the rear of the bolt assembly in a similar fashion to the Ruger M77, the bolt handle must then be pulled off the bolt body after which the mainspring and firing pin assembly can be removed. This is an ingenious little set up. If the shroud is lost or the plastic damaged with age - no problem; there are plenty of Tikka shooters who have hunting rifles missing their bolt shrouds.

Sako bolt dis-assembly is as easy as turning the bolt shroud clockwise a half turn, then pulling the shroud back. Assembly is simply a reversal of this operation. The Howa rifles are a close copy of the original Sako

rifles and therefore utilize a similar bolt design and the same dis-assembly/ reassembly procedure.



The Howa M1500 bolt. This is the same bolt (and action) found on the Weatherby Vanguard series rifles, the Vanguard bolts differing slightly in styling (fluting).



Savage bolt dis-assembly in steps.

Once the bolt is disassembled it should be cleaned, and if necessary, degreased. It also pays to try and clean inside the bolt body with soaking solvent and an air gun or by inserting a 4x2 patch on a cleaning rod into the bolt body. Once the parts are cleaned a light to medium grade oil should be used. This is a bit of a delicate balancing act. We need to cover the metal work with enough protective lubricant to prevent corrosion and allow smooth operation, but if we apply too much lubricant, we run the risk of inconsistent ignition, hang fires, or complete misfires.

For a greater understanding we need to wind the clock back yet again. If we look at the old military bolt actions of the world, the bolts were assembled with grease. However, it has been said that the mainsprings were much heavier than many of the bolt assemblies we see today. Mauser were particularly finicky about this; they worked out how much inertia was needed to ignite a primer and then set about making springs of far greater power than was required. This ensured that the Mauser rifle would work if the grease within the bolt assembly gummed during cold weather. Things aren't so straight forwards today, and although

grease is ideal for long term lubrication and corrosion protection within a part that we seldom check, a lighter grade lubricant can prove more reliable in modern rifles. My general recommendation is to use regular motor oil - preferably synthetic due to its favorable characteristics in cold weather. This is the same lubricant you will be using on trigger sears and bolt release mechanisms, so if possible, keep a jar of synthetic motor oil on hand for all three tasks.

After applying oil, the appearance of the parts should be wet but without surplus oil running or dripping from the mainspring or firing pin. Lighter grade gun oils (also CRC Long Life) can also be useful, depending on how the rifle is used. The more inclement the weather, the more we need to focus on either regular maintenance or the adoption of heavier grade protective lubricants. This really is about basic common sense.

Claw extractors are generally relatively easy to remove, as is the Sako style extractor. The Remington M700 extractor should not be removed unless it is being replaced (preferably with a Sako style extractor). In most instances, there is little need to remove extractors for cleaning. Nevertheless, on occasion a claw extractor (especially older Mausers) may need deburring and polishing, if it has been misused or is failing to snap over case rims when rounds are dumped into the chamber rather than fed from the magazine. This practice is very hard on claw extractors and not generally recommended. However, in some instances (dangerous game) it is important that the rifle feeds in worst case scenarios. To this end it pays to keep the front face of the claw polished while being careful not to weaken or grind back the claw edge which may result in extraction failure.

To remove a claw extractor rotate the claw, so that it is not encumbered by a locking lug. Next, compress the flat spring (the body of the extractor), as per the photo shown. This compression will release the

claw from its groove in the bolt head. Following this, slide the extractor forwards to remove it from the bolt body.

Compressing the flat spring on the extractor of a Ruger M77 (index finger). A simple push forwards will remove the extractor from its clip on the bolt body.

This basic claw assembly can be found on a host of rifle designs.

Winchester utilize a different system than Mauser for full bolt dis-assembly. The first step is the same: setting the safety to the middle position. This allows for basic dis-assembly and cleaning. If full dis-assembly is required, the bolt shroud needs to be secured and the mainspring pulled down - rather than securing the firing pin and pulling down on the bolt shroud. There are special jigs for this operation and for various bolt designs. In lieu of a jig, wrap inner tube around the mainspring in conjunction with the use of poly grips. Compress the mainspring to access the C shaped lock washer.

Following reassembly of the bolt, the outer bolt body needs to be coated in a light protective lubricant. After this the locking lugs should be checked and greased, if necessary. If the bolt handle features a blasted finish, I also rub grease into the handle and shroud.

Each time you return from the field the outer bolt body and handle should be lubricated for both rust protection and smooth functioning. The bolt face should be cleaned with a toothbrush. If there are carbon deposits (black ring) on the bolt face as a result of maximum pressure load development, it is extremely important that this carbon is removed with a solvent like Hoppe's No.9 and either a toothbrush or maroon poly pad. I generally use a very light lube on the outer bolt body and wipe only a trace of lube across the bolt face. If too much lube is used near the bolt face, it may travel into the firing pin hole and gum the mechanism. As I move away from the bolt face, I can apply a more heavy coating of protective lubricant to the bolt body. I lube the locking lugs and bolt handle with grease on a semi regular basis.

If the bolt is to be stored away for a very long time, a more dedicated rust preventative coating such as grease or CRC Soft Seal can be used for maximum protection. My preference in this instance is grease, as it is easy to wipe away and will not clog or gum working parts. It also pays to decock your bolt, so that the spring is not left preloaded for long periods of time which will eventually weaken the spring. This involves removing the bolt from the rifle and rotating the bolt shroud, allowing the firing pin to move to the fired position. Cock on closing type mechanisms such as the SMLE and unaltered Swedish Mauser rifles do not need this kind of attention, as the springs are only loaded when the bolt is in the action and cocked ready to fire.

Obviously I have neglected many brands of rifle bolt design in this section of our tutorial. The examples given here are merely an introduction. Further information can be found in manufacturers' owner manuals which are often available as downloads. There are now many online resources to help with bolt dis-assembly. In most instances, partial dis-assembly is all that is required for regular maintenance. Full dis-assembly (removing the mainspring from the firing pin) is useful as a

means to clean corroded parts or replace worn mainsprings but is not a task that you need to perform each time you clean your bolt.

Summary of Key Points:

- Clean and lubricate outer bolt body after using rifle (in conjunction with bore cleaning and protective lubrication).
- Clean and lubricate bolt internals once per year in general or regularly if hunting in inclement weather. Police or military to check on regular basis.
- If putting rifle into long term storage, decock bolt mechanism to release spring.

Protection of exterior metal work

Yet again I want to put forwards the idea that we have lost our way when it comes to protecting outer metal work. For many years, the military used grease (as well as Cosmoline in the U.S). These days, hunters barely bother to check inside the rifle stock. Grease is the key.

Whether your rifle is blued or stainless, you will need to pay attention to protecting metal work. Bluing offers pretty much zero protection while blasted stainless surfaces are equally prone to corrosion. That said, stainless is a very low care steel and the polished surfaces within the bore are highly resistant to corrosion. Nevertheless, trouble occurs when gun owners completely ignore stainless, forgetting that many rifle designs feature aluminum within the stock bedding which can produce a galvanic reaction, resulting in corrosion. Surface rust on stainless rifles is not generally difficult to remove, but it can become problematic in

regards to aluminum recoil lugs, breaking down the contact area and alignment while also degrading the stainless steel of the rifle. Moisture aids the flow of electrons which cause a galvanic reaction. This reaction can be either prevented or minimized via the use of grease and other corrosion inhibitors which block moisture.

I generally strip my rifles once per year but will also strip the rifle down, if I have been hunting in inclement weather. From time to time you will find that upon dis-assembly of your rifle the entire action appears very dirty - the trigger unit covered in grime. In such instances degrease the entire action using WD-40, CRC 5.56, Long Life, or similar. These types of solvent will clean but leave behind a fine protective layer. Use a toothbrush for scrubbing the action and be sure to clean inside the receiver where the bolt locking lugs engage with the breech face (beginning of the barrel). Following this, I use an air gun to blow out the entire action and trigger unit. If you do not have an air gun, a small can of compressed air can be very useful. Failing this, continued rinsing in lubricating solvent is the way to go. I do not generally use brake cleaner or turps type solvents during maintenance as these can dry out the locking lug rebate/breech face area of the chamber and also dry out the trigger unit. Nevertheless, there are times when I have to get stuck in with a harsh solvent on client rifles followed by flushing with WD-40 or CRC Long Life.

After you have cleaned the trigger unit you will need to make sure the entire in mechanism is well lubed. My preference is to spray CRC Long Life into the trigger unit, allow the surplus to drain away (or light blow with air gun), then apply synthetic motor oil to the sear and outer trigger unit body.

Lubing an M70 trigger. I use a cotton bud with one tip cut off at an angle to dispense drops of motor oil.

As described in the preliminary rifle setup section of this book, all hidden metal work should be coated with grease or a rust preventative product such as CRC Soft Seal. Grease can be rubbed in by hand and your hands need to be clean and sweat free which should not be a problem as you have just finished cleaning and degreasing the action. A stiff artist brush can be used to work grease into difficult areas. You can use a brush for the entire process, if you have concerns over salt deposits on your hands. Apply a fine coat of grease to all metalwork (including barrel), excluding the trigger unit and bolt release to avoid gumming.

Apply grease to both, seen metal (above the stock line) and unseen metal (below the stock line). Surplus grease can be removed, simply by

continual rubbing. The locking lugs of your bolt can also be greased at this time.

A fine layer of CRC Soft Seal (CRC SP-400) on old faithful. This product can also be laid in heavier coatings.

If using CRC Soft Seal for exterior metal protection, spray a fine film across the action, wiping away any heavy buildup. If using a paint on rust preventative (hard setting oil), again ensure that the barrier is thin and even. A thin layer is important because, if the protective barrier is laid on too thick, it can affect bedding tolerances in a negative manner. Heavier coatings can be used away from bedding contact surfaces. If in doubt, apply grease by hand, working it into the steel until you have a fine shiny layer. Do the same with the bedding within the stock, rubbing a fine layer of grease onto the bedding, a cotton bud can be used to swab the recoil lug recess. Once the rifle is assembled the action and

bedding will form a seal which will help prevent migration of water between the action and bedding surfaces.

If you wish to use a thin lubricant such as Rem Oil, Ballistol, or Long Life for surface protection, regular application is the key. It is important to understand that thin lubricants are mechanically displaced very easily during handling, hence the fingertip rust marks so common on rifle actions and barrels. If your rifle is glued and screwed, a thorough wetting with CRC Long Life on a regular basis can be very useful between strip downs.

Dedicated corrosion inhibitors can be very useful for long term metal protection, provided they do not interfere with bedding tolerances. These are the types of products used within car door panels and include petroleum wax or oil based products and fish oil based products. Again, CRC Soft Seal has to be one of the very best products I have used. Nevertheless, its application requires careful consideration. Soft seal dries to form a firm but slightly tacky layer. This layer can attract sand or dust and although grease can also attract dust, cleaning is much easier. It is therefore best to use Soft seal and similar tacky products on hidden metal work around the action and beginning of the barrel. Above the stock line and along the extent of the barrel, use grease, hand rubbing it in to the metal to form a fine sheen that will not gather a great deal of rust. Many of you will simply find it easier to use grease as an all-round protectant rather than use both types of product, but please do not discounts the merits of a semi solid protectant for long term rifle storage.

I use grease on my regularly used rifles, but I am now finding great merit in using Soft Seal on old Mauser and Enfield rifles, both below and above the stock line. These are rifles that I do not use on a regular basis, as I wish to keep the bore wear to an absolute minimum for long term preservation. I want to be shooting these rifles with their original

barrels decades from now. I may only fire off a couple of shots every few years in order to make the barrels last, the rest of the time the rifles will remain in storage with the potential risk of corrosion between inspections. A semi solid barrier coating not only provides a barrier between inspections, but also allows me to inspect these rifles (and show them to friends) without the risk of mechanically shifting (bumping/handling) the protective coating. Ultimately, Lanolin based grease and/or Soft Seal are my current go-to products for exterior metalwork protection.

Grease laid on relatively thick during initial application. If the rifle is to be stored away, the grease can be left proud. But if the rifle is in use, surplus grease needs to be removed for basic handling and to prevent major dust adhesion.

The grease has been rubbed in, leaving only a fine layer behind. Below the stock line the grease layer is somewhat heavier.

Exterior maintenance of metal work is very straight forwards. The main point I wish to convey is that all metal work, whether blued or stainless, requires some form of corrosion protection and should be inspected at intervals. The time span between checks is based on rifle usage, weather, and so forth.

Should you discover any rust, you will need to decide how best to remove or neutralize it. Very light rust can generally be rubbed back by light cleaning, a coat of grease preventing any further corrosion (similar to rust browning). Heavier but sporadic deposits will require spot removal and touch up bluing (chrome moly), while badly rusted rifles may require a trip to the gunsmith for a full overhaul. I generally use maroon poly pads for spot rust removal (light circular motion) however

grey poly pads can also be useful, especially for light rust on stainless steel without any alteration of appearance. Autosol is very useful, both in conjunction with poly pads and for finishing. I also use acid based neutralizers; however, these are more within the realms of general engineering.

After the removal of rust from chrome moly rifles, touch up gun blue can be applied to blend the finish. But please understand that this offers no corrosion protection and is purely aesthetic. You will need to follow the manufacturer's recommendations which will include basic steel preparation, degreasing, applying the blue, then neutralizing. I prefer to rinse any touch up blued areas with WD-40 or CRC Long Life, then apply grease or a similar product for long term preservation. If your rifle is parkerized, it will have a degree of protection but will still require greasing. Light scuff marks (bare steel) can be treated with touch up blue for an appropriate color match. But again, without protection these areas will continue to rust.

As suggested, grey poly pads and Autosol generally make short work of rust on stainless rifles. Light circular rubbing is the key on blasted surfaces. Marred finishes can easily be blended with light bead blasting. Again, this would be more within the realms of general engineering and gunsmithing.

If your rifle is to be stored for a very long period of time (work contract overseas, etc.) a second step can be taken to help ensure protection. After the application of a corrosion inhibitor, wrap the entire rifle in cling film, carefully making sure that the rifle is thoroughly air tight. Silicon gel sachets can also be utilized for added protection if need be.

Summary of Key Points:

- Exterior (including hidden) metal work needs to be checked, cleaned and protected on a routine basis.
- Clean and lube trigger during routine maintenance.
- Clean and lube bolt stop.
- Use grease or rust preventive coating on exterior metal work.
- Bolt locking lugs can also be greased when performing exterior metal care (when grease is on hand).

Paint surface coatings

In more recent years paint has become very popular as a surface coating for rifles.

There are two general methods of employment. The most basic being the application of black, green or tan paint to the metal work of the rifle in order to either prevent corrosion (chrome moly) or change the appearance of stainless to reduce glare. It is however important to understand that stainless glare can be reduced by course garnet blasting as opposed to the fine glass bead often used within the firearms industry. A garnet finish creates a dull gun metal grey finish.

The second method of employment concerns the painting of the entire rifle, including the stock, action, barrel, bases and rings with a camouflage pattern. A full paint job of this nature can offer elements of both, practical and aesthetic appeal.

But while the process of painting may seem a relatively straightforward proposition, it is not without complexities. If the action is painted before bedding, the paint will often chip during the bedding process, effectively

ruining the surface protection. If we paint the action after bedding, it may ruin bedding tolerances; especially if a protective coating is applied over paint for added insurance. As suggested in my first book, I recommend painting above the stock line only - after bedding. The entire barrel can be painted but if the barrel is bedded (first 1-2”), this area should be masked off. Unpainted metalwork can then be greased. This metalwork will remain protected.

One of the simplest methods of painting is to basically assemble the rifle with hidden metal work greased, muzzle plugged, action blocked off, then paint the entire rifle. I am not a great fan of painting the bolt and believe that this is perhaps best suited to dedicated sniper rifles if bolt glare is a potential problem. The bolt is a high wear area with a potentially negative effect on paint finishes. If painting the bolt of high end custom rifle actions, tolerances can at times be effected to the point that feeding becomes somewhat sticky. The bolt should therefore be treated with caution.

If your rifle is already painted and you wish to perform a bedding job or glue and screw job, it is imperative that you pay special attention to the application of release agent.

A basic black epoxy paint finish.

There are now several brands of paint designed specifically for rifles. The rules here are very simple. Basic enamel paints are easy to apply but are not overly tough. I tend to use flat enamel paint for touch up jobs on HS and Bell & Carlson stocks but not as a general paint. Epoxy (two pot) paints offer tough protective finishes. These are the rules and in my experience brand of paint is secondary to type of paint. If you want a tough finish, adopt an epoxy paint. In New Zealand we have smiths that offer Milspec Coating services and also DuraCoat which is perhaps better known worldwide. Both are epoxy based systems. DuraCoat is sold in DIY kit form and is also sold in commercial pack sizes. DuraCoat also manufacture removable, mission specific paints for short term use. As brands go, DuraCoat have it covered.

With any paint system, preparation is the key. Basic steps include metal blasting and degreasing to ensure the paint can mechanically adhere to the steel surface. All threaded holes and cut outs must be plugged during both, blasting and painting. Following this, paint can be applied

to the steel utilizing an air brush, air gun, or aerosol can. Temperature and humidity have a pronounced effect on curing - although epoxy paints are far less susceptible to environmental factors than enamel paints. The former cures via a chemical reaction, the latter cures through solvent evaporation. If you intend to paint your rifle and need advice, talking to an automotive painter or automotive paint supply company is the way to go.

As suggested in my first book, it is important to avoid painting inside the action. I have seen some utterly abysmal paint jobs over the years where paint has been allowed to run into the action, the lug rebates and action screw holes. Yes, our good old tactical 'chop shop' "custom rifles" - all the bells and whistles, but no brains.

Once a rifle is painted the paint can be very difficult to remove, something few people consider. Paint removal generally requires both, stripping with a chemical agent along with blasting. This work can consume many hours, especially if scope bases and rings have been painted. It is therefore important to take a long view. Once we paint we are generally committed to the process, including barrel repainting after barrel swaps as well as touch up painting as required. Any rebedding work may also mar the paint surface and in worst case scenarios may necessitate stripping and repainting.

A paint finish can certainly look smart, but there is a lot to consider. Personally, I have seen too many 'chop shop' jobs over the years which to a large extent have put me off painting metal work. I have also seen folk neglect the bores of their rifles due to a lack of external indicators (e.g. dryness, surface rusting). Another negative aspect of paint is that it does not easily adhere to plastic rifle stocks. I have seen folk use basic enamel paint from a spray can, based on the premise that the paint on the stock will no doubt chip. Therefore a spray can is very handy for touch ups, as opposed to the full process of epoxy painting. This method

of employment certainly has merit. On the other side of the coin, epoxy is generally tougher to begin with. I don't know if there is such a thing as a right or wrong way to go in this instance. One of my clients used VHT wrinkle paint on his laminate rifle stock (not metal work), followed by an enamel camouflage finish which adhered very well to the wrinkle base. Two years on, and the stock is still looking and performing very well. Furthermore, the wrinkle finish also boasts superior handling qualities with the potential for enhanced accuracy, similar to that described in the tape and paint section ahead.

Whichever way we go, rifle painting is not as straight forwards as some might think and requires careful consideration.

Summary of Key Points:

- Painting requires careful consideration with regard to bedding practices and tolerances.
- Painting above the stock line with greased bedding is preferable.
- Epoxy paints produce tough finish.
- Paint does not adhere well to plastic and may require regular touch ups.

Tape and paint

As described in The Practical Guide To Hunting Rifles, this is my preferred camouflage surface coating method due to the fact that stripping is very straight forwards. The tape and paint matrix is incredibly tough but can be removed with ease simply by peeling back the tape.

In essence the stock along with the visible metal work is covered with Elastoplast (sport tape). Stock taping can be performed in an irregular fashion in conjunction with the irregular camo painting. The tape can also be built up - up to three layers thick. The fit of the taped action needs to be checked within the taped stock to ensure the bedding surfaces are not compromised. The entire barrel can also be taped (bar the bedding surfaces), but some stock material may need to be removed to ensure the barrel remains free floating. Tape along the forend of the stock can also be laid in such a way that the tape edges are folded into the barrel channel. Be careful when taping the bolt handle recess in the stock: make sure the root of the bolt handle is able to ride home when the rifle is assembled.

Once the taping is complete the rifle can be assembled for painting. I do not tape the floor plate of rifles, the rings or bases. This is a very basic surface protection. The first layer of paint can be hand painted or sprayed. The first layer needs to be very thick to build the tough matrix, filling the pores within the cloth tape.

My tape and paint kit, including paints, sports tape and an airbrush. The first layers are painted on with a brush, final layers are air brushed. Spray cans can also be used.

Cheap enamel paint forms an extremely good bond with sports tape, but needs to be applied in thin coats; otherwise the solvent base cannot evaporate, taking up to four weeks to dry tough. Therefore, if applying basic flat enamel paint, use thin coats. Continue to build up the base layer until it is a very obvious, tough matrix. If using epoxy paint, a full base layer can be achieved in one paint session. Following this, overlay the job with your chosen colors and allow your creative talents to shine through.

One of the practical advantages of tape and paint is that it can improve rifle accuracy via superior forend grip. A couple of years ago I had a somewhat troubled client who was having great difficulty shooting a

laminate stocked rifle I had previously tricked up. I spent a great deal of time at the range with the client trying various traditional and new shooting methods - nothing worked. I could shoot the rifle, the client struggled. On a whim, I asked the client if it would be OK, if I kept the rifle with me for a couple of weeks to check things over. The thoroughly dejected client agreed. I think he would have been fine, if I suggested we store the rifle at the bottom of the ocean.

During the two weeks I taped and painted the rifle. I also sprinkled a very small amount of grit onto the forend to increase grip, although the tape and paint matrix is already very coarse. The client returned to discover that his laminate stocked rifle had become a camo wonder beast. Better still, the client shot well. I cannot overstate what a dramatic difference this made, reducing group size from 1.5" with POI woes to repeatable sub half inch accuracy with a consistent POI. The client's first group was as good as his last group, and within a couple of hours he was shooting his rifle out to 600 yards. Food for thought, huh.

Tape and paint is also an excellent form of protection for wood rifle stocks and also adheres to plastic stocks, offering a degree of sound deadening properties (sound made when stock bumped). The cloth and paint matrix is long lasting, provided a thick base layer is created along with appropriate drying/curing times. If you are looking for an excuse to go camo, this is it.

A close up of the tape, paint and grit finish on the rifle that previously had proved troublesome for one of my clients.

Note how I have addressed the tape edge. Along the action area of the stock, I have taped close to the edge of the bedding. Further along the tape is folded over and tucked into the barrel channel.

In the past I have used tape and paint to protect the stock, metalwork and optics (see first book). In the above example, only the stock is protected.

Summary of Key Points:

- Easy to apply, easy to remove.
- Tough matrix.
- Potential for enhanced rifle accuracy.
- Apply to stock and seen metal, plus barrel.
- Do not apply to bedding surfaces, perform careful checks, trial fits.
- Check bolt handle can ride home.

Care of painted stocks, painted metal and plastics

Any painted stocks including those produced by HS Precision, McMillan and Bell & Carlson require basic care. The paint we use is derived from the automotive industry; therefore care is much the same apart from one major concern - texture.

A painted stock (or metalwork) with a flat finish is ideal for reducing glare while offering superior handling (grip) qualities. There is nothing worse than a slippery stock or knife handle. The downside of a flat paint is that the surface friction can cause paint wear. In some instances a semi sheen can offer a balance of low friction and good protection. Examples of this can be seen in the McMillan line of rifle stocks where a semi sheen paint is used in conjunction with textured stock surfaces.

The simplest way to care for a painted rifle stock is to simply wash the stock with a damp rag and mild household cleaning agents. But as for protection, auto body wax offers optimum protection. That said, wax has the obvious disadvantage of creating a slippery surface. The only compromise I have found is to use a damp rag, apply a very light coat of wax, then buff the stock, then test the handling of the rifle. If the finish is too slippery, a damp cloth can be used to rub the wax finish back further. There are no easy answers here. There are also spray waxes, both aerosol and water based along with lubricants such as Lanox which will not harm paint. CRC Long Life can also be used as a basic spray and wipe cleaning system. Unfortunately it is the sheen produced by wax or oil that offers greatest protection, yet a high sheen poses the problem of negative handling qualities.

Plastic rifle stocks can be cleaned with a basic car vinyl/plastic protective coating. In New Zealand and Australia, Armor All is one of the best products for plastic stock protection. This product is also available in the U.S and UK, but again I do not wish to get too heavily into brand names. All we are looking for here is a basic U.V. protectant to prevent

plastic degradation while offering an aesthetically pleasing appearance. Plastics can also be hand buffed with poly pads and Autosol laden rags in order to remove scuffs. However this process is not ideal, as some plastics develop a tarnished appearance; therefore such practices are best left until the stock has an overall tardy appearance.

Summary of Key Points:

- Clean painted stocks with damp rag and mild acting household cleaner.
- Light wax, lanolin spray or light oil (CRC Long Life, etc.) can help protect paint but can also negatively affect handling qualities.
- Use plastic/vinyl protector on plastic stocks.

Wood and laminate stock care

There are two types of wood finish used within the gun industry - hard oil and urethane (epoxy). Hard oil can be further subcategorized into dull oil (to reduce glare) and high sheen (for increased aesthetic appeal and optimum protection).

Urethane is generally used by U.S manufacturers for mass production purposes and has a hard, clear plastic like appearance. Hard oil is commonly used in Europe. High sheen hard oil is found on high end rifles, including custom stock designs. I am not a fan of urethane finishes because these eventually begin to peel and it is difficult to blend touch ups. In the end the entire stock needs to be stripped, after which a hard oil can be applied.

Paint stripper can be used to strip a urethane stock; the process can also be sped up, using a scotchbrite wheel - with care! Following this, dents can be removed with a steam iron and towel. The timber can then be sanded, whiskered, and brought up to a suitable finish for staining and hard oiling. For those who have no experience with stock finishing I thoroughly recommend the Birchwood Casey stock finishing kits. I do not wish to diverge into a full woodworking tutorial here, and besides I am far from a woodworking expert. Stock finishing is essentially within the realms of cabinet making. A great deal of help can be sourced from hardware stores, furniture renovating specialists, and also via the DIY type kits, as produced by Birchwood Casey - an excellent starting point which also includes sealing stains.

Medium sheen hard oil stocks are certainly the easiest to care for. The medium (semi-gloss) sheen is obtained with three to four coats of hard oil. Over time and with usage, the finish dulls off further as the wood grain is revealed. Basic cleaning can be performed, using a light furniture maintenance oil (oil based furniture polish). That said, Danish, teak or Birchwood Casey Tru-Oil oil provide superior protection, and these products are ideal for both, maintenance and full refinishing. These oils should be rubbed in by hand (fingers) and the surplus wiped off with cheese cloth, then left to dry with buffing after approximately 12 hours.

Applying a Briwax teak oil finish by hand during general maintenance. Briwax make excellent wood finishing products and also boast excellent customer support.

High sheen stocks can be somewhat problematic. The sheen is built up by applying sometimes between ten and thirty coats of hard oil. Basic care is straightforward, utilizing oil based furniture polish. But if the finish becomes marred, it can be difficult to touch up a high sheen stock. In such instances it is sometimes better to (slightly) rub back the entire finish with solvent and scotchbrite or steel wool, then apply a fresh coating or coatings of teak oil.

Hard oil does exactly as its name suggests - it sets hard. In reality, hard oil is a mixture of both oil and varnish. The oil is absorbed into the stock but then sets hard. I also like wax finishes; but after being told by many a woodworker over the years about the inability of wax to penetrate

and seal in the same manner as a hard oil (plus the difficulty of removing wax in preparation for oil) I now refrain from using wax on wood rifle stocks. In days gone by stock makers used Linseed oil - a very slow process which involved multiple coatings and very long drying times. A period followed where stock makers made their own hard oils by mixing varnish with linseed oil. Today we are fortunate to have dedicated hard oils. My essential kit basically incorporates teak oil as my weapon of choice for sealing, protecting and maintaining wood. I try to avoid high sheens (multiple oil layers), maintaining a semi-gloss sheen which is easy to touch up on a year to year basis by simply rubbing the entire stock lightly with a fresh coat of teak oil, often without any stock preparation apart from basic cleaning.

Laminate stock care is essentially the same as wood care apart from the fact that a hard oil can only soak into the laminate so far due to the epoxy layers within the laminate. Most laminate stocks are urethane coated and in some cases, the urethane finish is very slippery in the absence of checkering. Laminate is generally a very easy material to work with and can be stripped back and refinished with hard oil without fuss. A hard oiled laminate stock has far better handling qualities than one with a urethane finish as well as looking very smart.

Summary of Key Points:

- Light furniture oil can be used for regular maintenance.
- Hard oil finishes preferable for refinishing.
- Dull or semi sheen hard oil finish is the easiest to maintain.

Rifle suppressor care

To begin with: After each shooting session, you must remove your suppressor and clean the muzzle of your rifle! That thick black carbon buildup is as sinister as it is ugly. If it is left to its own devices, the carbon deposit at the muzzle of your rifle will attract moisture, the steel at the muzzle (both chrome moly and stainless) will corrode, and after that it's goodbye accuracy. So, step one is to remove the suppressor and clean the muzzle of your rifle.

Unfortunately, due to the sealed construction of centerfire suppressors it is impossible to inspect the inside of a suppressor. Cleaning is problematic, in that without inspection we cannot see if carbon has been removed via solvent soaking. Furthermore, it is difficult to remove solvents from suppressors - a potentially dangerous situation.

Just about the only cleaning operation that can be performed safely and successfully is the brushing of the suppressor bore (not the baffles) with a suitable bronze bristle brush to prevent any reduction in diameter. Extremely heavy carbon deposits can tighten up the bore of the suppressor to the point that accuracy is affected. It is therefore important to regularly run a bronze brush through the suppressor to prevent this potential problem. One of the best solvents for this task is KG 1 Carbon Remover. This product works very well but it is important to understand that mechanical action (i.e. bronze brushing) is required to help the solvent etch into carbon.

Carbon can also buildup on both, the threads of a suppressor and rifle muzzle. If left unchecked, this can lead to the galling of threads. Obviously it is important to clean these areas with a carbon solvent such as Hoppe's or KG 1. A poly pad can be used to scour muzzle threads while a bronze brush and solvent can be spiraled around suppressor threads. After cleaning threads apply a very light coating of grease, making sure to avoid any surplus buildup which may be forced back into

the rifle bore under back pressure. Loctite Anti Seize is also very useful as a muzzle thread coating.

During cleaning sessions, make sure you look into the bore of the rifle, checking for heavy carbon deposits that could ruin accuracy both short term and long term. If your rifle is reliant on a layer of carbon fouling in the bore to shoot well, you will need to decide on a set regime with regards to when you perform a dedicated carbon removal session within the bore. Another ultra-important area to check is the chamber of your rifle. Suppressors have a bad habit of throwing carbon back into the chamber which after a period of time becomes compacted to the point of reducing chamber dimensions. It is therefore absolutely imperative to keep the chamber of your suppressed rifle clean using a slightly oversized bronze brush and solvent, paying particular attention to the neck area of the chamber. If you are in doubt as to whether your chamber dimensions have been reduced, try passing a projectile through the mouth of as fired case. If the projectile is pinched, you have a crabon buildup problem. Such a problem can cause pressures to rise, velocities to rise and at longer ranges can cause elevation errors of up to 1 yard / meter or more from shot to shot.

If the suppressor is an over barrel design, it also pays to check the fit of the rear collet bushing. The collet should fit tight against the barrel without play. If the suppressor body can be wriggled in any way, the suppressor will render the rifle inaccurate. Play can sometimes be taken up with electrical tape on the barrel, but in most instances a new suppressor or collet is the fix.

It is extremely important to store your suppressor away from the rifle, as the carbon within the suppressor will attract moisture. This may cause muzzle or barrel corrosion, resulting in poor accuracy. I cannot believe folk even entertain the idea of keeping rifles stored with suppressors fitted - yet this is common. If you are a military operator,

you sure do have a great need for readiness (and regular rifle maintenance). Any damage to the military rifle can be addressed at the end of deployment. Police tactical operators sit somewhere between military and civilian users - very few police operators patrol with a suppressed rifle on a day to day basis. It is up to you to use your common sense in this regard. Hunters do not need the same state of readiness and can therefore take the time to remove a suppressor for storage.

I have not yet looked into the ultrasonic cleaning of suppressors. There may also be other methods or systems for cleaning. I have yet to try Youngs 303 cleaner and boiling water - now that would be a step back in time!

One point I really want to drive home is that discarding the suppressor after a set period of time is perhaps of greater importance than internal maintenance (apart from bronze brush cleaning).

If I can offer one piece of advice, it is that the suppressor should be discarded with each barrel swap due to potential metal fatigue. I would suggest 2000 rounds as a maximum round count for a suppressor, the potential for metal fatigue increasing thereafter - depending upon the type of steel used to make the suppressor. Failure to discard the suppressor after a set period of time can lead to disastrous consequences. If you are a military operator utilizing a suppressed assault rifle, discard your suppressor after each deployment and requisition a new unit on the grounds of potential metal fatigue. Spare suppressors should also be made available during deployment in the event of falls or accidents which may bend the unit out of alignment. Just remember, the suppressor has a very small hole through its bore (a touch over bullet diameter), designed to capture all expanding gases. It does not take a great deal of force to ruin this alignment.

Suppressors are very useful tools, but as suggested in book one they can be highly dangerous. Too many people treat suppressors as everyday items rather than specialized tools. Due to the popularity of our books and website worldwide I receive many emails from shooters who have experienced suppressor ruptures, constantly reminding me of the potential dangers.

This photo shows carbon fouling after six shots from a rifle fitted with a suppressor. It is hard to believe that under this carbon lays a highly finished new bore. If this carbon is not removed after shooting, it may attract moisture during storage, resulting in serious corrosion.

Summary of Key Points:

- Clean rifle muzzle and threads after each shooting session.
- Clean suppressor threads after each shooting session.
- Bronze brush and solvent can be used to clean suppressor bore as necessary.
- Make sure collet fits tightly to barrel (over barrel designs).
- Watch for excessive carbon buildup within the bore of the rifle- especially the chamber.
- Keep all threads greased.
- Store suppressor away from rifle.
- Discard suppressor when re-barreling.
- Military operators should discard suppressors on a regular basis.

Muzzle brake care

I don't know why this continues to surprise me, but it does. I often come across rifles with thread locked muzzle brakes. The smith cuts the threads, makes or obtains the brake, then welds the brake in place with a Loctite product. This simply goes against common sense. It is imperative that you remove your muzzle brake after each shooting session in order to remove carbon from the muzzle of your rifle, thus preventing corrosion and therefore muzzle damage. No cleany cleany, no accuracy, no shooty shooty! I hope that is simple enough to understand for both end users and 'chop shops'.

Brake care is essentially the same as suppressor care. Use a good solvent such as KG 1 in conjunction with mechanical etching to remove heavy carbon deposits from the brake and bore of your rifle. And again,

if your rifle bore is reliant on a certain level of carbon for optimum accuracy, you will need to determine a set regime as to when you fully strip carbon from the bore. Just don’t leave it too long.

Keep the threads of both the rifle muzzle and brake clean, removing all carbon deposits. The bore of the brake can also be cleaned with a bronze bristle brush. As opposed to a suppressor, it is also possible to soak a brake and clean each of the ports, removing all carbon if necessary. The brake can also be sprayed and soaked in CRC Long Life.

After cleaning the rifle muzzle, the brake and threads, apply grease or anti seize to the threads, being careful to avoid surplus grease. The rifle can then be stored with the brake fitted.

Summary of Key Points:

- Clean rifle muzzle face and threads after each shooting session.
- Check the bore for heavy carbon deposits.
- Clean brake threads after each shooting session.
- Clean the bore of the brake with a bronze brush and solvent as necessary.
- Apply grease or anti seize to threads, wipe away surplus.
- Entire brake can be soaked in solvent as and when required.

Care of optics

A rubadubdub and oh crap - how did that scratch end up there? I think a lot of us tend to neglect scope and binocular care, these being the last on a long list of jobs which require attention to detail.

To begin with, good scope and bino covers help provide excellent protection in the field. But there comes a point where scope covers need to be left off the rifle or in the open position so that we can maintain readiness, the same goes for binoculars. Dust and mud are both common problems for the hunter, sand for the desert hunter or soldier. These abrasives cut into lens coatings and in some instances, cut into glass. Over time, lens quality deteriorates. Just think of how many sunglasses, safety glasses or corrective glasses you have been through - and yet we expect our scope lenses to last a lifetime.

Ideally, we should all be carrying a full range of lens cleaning equipment into the field but the truth is, we can only carry so much kit before we are bogged down with weight and bulk and start losing track of each item. To this end, lens cleaning is often overlooked and put into the too hard basket. Many hunters simply decide against carrying any lens cleaning kit into the field to the detriment of their optics.

It is important that we have a practical plan for lens cleaning, broken down into two elements, home care and field care. However, we first need to develop an understanding of the three tools we will be using - a soft brush, microfiber cloth, and lens cleaning solution (or breath moisture in the field).

A soft brush (or brush with air bellows) is used to remove abrasive sand and dust without scratching the lenses. A microfiber cloth (usually sold with scopes) can be used to clean the lens with either breath moisture in the field (breathing on the lens) or a dedicated lens cleaner at home. It is important to keep your microfiber cloth clean and to put it through

the wash once in a while. Lens cleaning solution is available from camera stores and optometrists. Few people are willing to carry extra liquids into the field and lens cleaner is therefore often considered a home item. lens cleaner is not to be confused with window cleaner, the ammonia base in window cleaner can be very harmful to lens coatings. In fact, dish detergent and warm water is a much safer alternative. Meths is another alternative.

The main concern with lenses is not simply dust or grime buildup, but how we deal with that contamination. Any scratches will normally be as a result of our cleaning processes rather than direct knocks and abrasion. Knowing this, we need to very, very careful in our approach to lens cleaning.

Lens cleaning at home consists of brushing (or brush and air bellows) to remove dust, followed by washing with lens cleaner, then very gently wiping the lenses with a microfiber cloth, changing to different areas of the cloth as you go to avoid cross contamination. Wipe in a circular motion until the lenses are dry. Pretty straight forwards. Field cleaning can be a little bit trickier if we do not have the right kit on hand.

Field cleaning in its most rudimentary form generally involves breathing on lenses and gently rubbing with a soft cloth, essentially missing the brush step- not ideal. If I could offer one piece of advice, it would be- adopt a small soft brush and microfiber cloth, keeping both handy (on your body if possible) in a zip or snap lock plastic bag.

A more recent tool is the inexpensive LensPen. This has been adopted by various optics manufacturers including Nikon and Leupold and is a handy field tool featuring a retractable brush at one end and a microfiber pad at the other which needs to be discarded after around 500 cleaning sessions. The one limitation of the LensPen is that it is not designed to dry wet lenses. In this instance, a soft flannelette patch

(4x2) or microfiber cloth needs to be kept with the LensPen if it is to be used in the field.

If you are genuinely stuck without a brush due to circumstances, use a soft cloth (4x2 flannelette) in a dusting motion without pressure to remove dust or rain drops, then discard the piece or section of cloth before cleaning with a microfiber cloth or fresh 4x2 cloth.

Rain drops on lenses combined with dust are highly problematic in the field, as is splashed mud. Once lenses are contaminated in this way, the lens needs to be flushed either lens cleaner or with warm water and dish detergent. Dish detergent is something we can carry in the field in a very small bottle (use for both dishwashing and bathing) if backpack hunting or hunting from a hut- but it is not something one would generally carry with day kit. Fresh water flushing is therefore the only alternative if a caked obstruction needs to be removed when in the field and away from either a hut or base camp.

To reiterate, a brush (or brush and bellows), plus lens cleaning solution and microfiber cloth is ideal for general care. That said, few people take lens into the field. If we do not take all of these items into the field, we must adopt basic tools and procedures to prevent damaging lens. A small brush and microfiber cloth in conjunction with breathing as a lens cleaning solution is our most basic option. A LensPen is ideal for field care but must be used in conjunction with a drying cloth to remove rain drops. Heavy contaminants need to be flushed out with water- ideally warm with dish detergent but fresh water can or may have to suffice.

The LensPen, a very handy tool for cleaning optics.

The cloth used for lens cleaning is perhaps one of the most important aspects of field care. Your singlet may seem ideal but clothing picks up dust and debris. The small yellow/tan microfiber cloths are the best and as suggested, can be kept handy in a small plastic sealable sandwich bag. Microfiber cloth is often provided with new scopes but can also be obtained from optometrists. Grocery stores now sell a similar type item for streak free window cleaning. These cloths can be cut down into smaller sizes for field kit. New scopes also generally come with flannelette cloths (along with microfiber cloths) which is an acceptable scope cleaning material. 4x2 flannelette cloth is another safe option. Nevertheless, please try to adopt microfiber cloth if at all possible.

On my last hunting trip, everything got wet due to heavy rain. My microfiber cloth was relatively small so to dry lenses, I used 4x2 patch as an intermediate step, applying no pressure, simply soaking up surplus water until I was satisfied that I could use the microfiber cloth in a way that would ensure it could be used multiple times throughout the hunt without becoming fully sodden or heavily contaminated. It is certainly

worth keeping the two types of cloth together if hunting in wet environments (much the same as keeping spare cloth for a LensPen). One of the limiting factors of the microfiber cloths that are sold with scopes is that they do tend to be very small. Cloth sold by optometrists tends to be larger in size and somewhat more practical for field use.

The outer anodized surface of the scope body can be cleaned with light oil (CRC Long Life etc.) on a rag but try to avoid too much oil on the scope body as it can very easily end up smudged on lenses. Following this, grease the rings, being sure to plug the screw holes with grease. An anodized scope finish is very tough and needs little care other than very light cleaning and wiping dry once you are done while ensuring the base, rings and screws are fully protected.

I wash my binoculars in warm clean dish water every month or so. I do not fully submerge them but they are given a thorough cleaning. I then set about cleaning the lenses with lens cleaning solution and a microfiber cloth. My Binos (Leica) have a built in rangefinder so I also pay special attention to the laser lens.

Once the unit is clean and dry, I rub the binocular body down with Armor All (plastic and vinyl cleaner) to protect the rubber housing.

Optics can take a hammering in the field. Considering the amount of time we can spend glassing for game, care of optics needs to be a primary consideration.

Summary of Key Points:

- Use a lens brush (with or without air bellows), microfiber cloth and lens cleaning solution for home care.
- Use a brush, microfiber cloth and breath in the field along with spare 4x2 cloth if hunting in wet environments.
- Absolute minimum field kit to include 4x2 cloth (brushing motion) followed by microfiber cloth and breath.
- LensPen very simple and handy field item and should be stowed with spare microfiber cloth or 4x2 patch to

remove rain drops.

- Keep field kit close to hand.
- Flush heavy contamination with clean warm dishwater at base camp or home.
- Clean scope body, grease rings and bases.

Conclusion

So ends the task of passing on my basic methods for accurizing rifles. It was a hard journey I know. Some of you will have absorbed everything in one reading, some of you are still wondering if you will ever reach this conclusion section, and therefore have no clue as to what I am writing here. Some of you may still be wondering what an action screw is, while a few of you will be cursing Google Translate for its ability to make every sentence completely wrong and somehow sound very rude (which can also be a heap of fun).

The trick my friends, is to be patient. If there are aspects of this book that you have struggled with or if the tasks seemed at times overwhelming - be patient. Sometimes we want to run before we can walk and it is at these points in time that rifle accurizing or maintenance tasks can seem overwhelming. But I can tell you from experience that you can achieve your goals if you are willing to exercise a little patience. You do not have to be a rocket scientist to follow these processes.

If things go wrong for you during your learning phase, remember what I have said about perspective. Your rifle is not the life of a child, it does not involve the fate of the world. At the end of the day, it is just a piece of steel and a stock. Try to learn to accept whatever comes your way and if things don't go well, just remember that you get to choose how you react and how you feel about it all. With this mindset, you will be able to overcome obstacles and move forwards towards success. By the same token, overconfidence can be very limiting. This is the path to the 'chop shop' side of the force.

An accurate rifle is something to behold - a marvel of mechanical engineering. The pleasure in its use is something that cannot be put into words. I am sure that primitive hunters (and there are still primitive tribes on our planet) have derived the same pleasure from tillering a bow or balancing a spear when trying to make that one shot count. I fully believe this is an instinctive function within those of us who have strong hunter or warrior genetics. We literally feel the hunt in our gut as I am sure you will agree. There is no other feeling like it, a chemical concoction which makes us who we are. It is a positive trait when balanced with a compassionate mind. The process of accurizing a rifle and rifle maintenance is simply an extension of this genetic trait, the same as the tribal hunter balancing his spear. So follow it, follow your natural instincts and enjoy the process.

All the best, Nathan.

Check lists

Full bolt action rifle checklist:

1. Degrease chamber and bore, then prep bore for shooting with or without shoot over lube.
2. Check optics for dust residues and clean as necessary.
3. Routine field maintenance if away hunting for extended periods. Base and pack down kit on individual rifle needs. Include optical cleaning kit.
4. Shoot.
5. After shooting- if too tired to clean rifle, apply protective coating inside and out until ready for full cleaning- or use Hoppe's No.9 or similar as an intermediate step prior to full cleaning. Pull through very useful for speed and simplicity.
6. Commence full cleaning session when ready but in a timely manner. Maximum time period 7 days.
7. Consider carbon removal as a preliminary step before copper removal if shooting a suppressed rifle.
8. Clean suppressor/brake threads.
9. Remove copper fouling from bore with either an aggressive solvent or light solvent for low fouling bores.
10. Degrease/neutralize solvents after cleaning.
11. Polish the throat as necessary.
12. Degrease bore after polishing (or use dry patches).
13. Coat bore with protective layer for storage.
14. Coat metal work with protective layer for storage and field use.
15. Clean bolt face and lightly lube bolt.
16. Clean and protect stock as required.
17. Clean optics.
18. Back to start- Degrease chamber and bore, then prep bore for shooting with or without shoot over oil.

Yearly bolt action rifle strip down checks:

1. Strip rifle and degrease with WD-40 or CRC Long Life etc. Utilize Long life to both clean and protect internal action raceway and breech face etc.
2. Lube trigger inside and out (light lube).
3. Lube bolt stop/bolt release mechanism.
4. Apply protective coating to all metal work.
5. Reassemble rifle, be vigilant of fit, magazine pinching etc..
6. Set action screws to pre-determined torque screw settings.
7. Ring screws can also be checked for torque.
8. Strip and clean bolt mechanism, light lube, then re-assemble. Grease lugs.
9. Clean and protect stock.
10. Monitor suppressor lifespan, discard as necessary.
11. Recheck rifle zero.

Long term rifle storage:

1. Use grease or adhesive oil or wax based rust preventative product on internal and exterior metal work.
2. Grease outer bolt body, light oil/lube generally sufficient for mainspring and firing pin.
3. Use aggressive degreaser within bore and especially chamber after storage, prior to test shooting.

   If you are concerned about forgetting that you have grease in the bore, write a note on a piece of flagging and attach to rifle.

Semi and full automatic rifle care:

1. Replace heavy creepy trigger units if at all possible. (Consider Jard triggers for AR rifles).
2. Sporting rifles - apply grease to hidden metal work, non-moving parts.
3. Utilize light lubricants on all working parts - regular re-application.
4. Strip military and sporting rifles regularly and remove carbon deposits from action and gas system in order to prevent both corrosion and malfunction.
5. For Military/police rifles, adopt light lubricants with additional dry film qualities if possible. Apply regularly for lubrication, carbon deposit prevention and corrosion protection.
6. Spray can lubricants very useful for wide coverage, full migration and carbon flushing. Note: CRC Long Life (CRC SP-350) featured a high degree of dry film lubrication during my testing. Although corrosion protection was lost after being mechanically shifted away from steel (or burning), its lubrication qualities remained as a result of fine residues. This product is not however advertised as having dry film qualities.
7. Military/police rifles in or near aquatic environments - hand rub grease onto external parkerized metal surfaces. Adopt shoot over lube.
8. Remove flash hiders if possible in order to remove carbon deposits from muzzle and threads. Refit with grease or Never Seize.
9. Stripping and reassembling a rifle within 60 seconds has no bearing on rifle care or expertise. Look beyond the basics.

Lever action rifle care:

1. Use light lubricants within action on a regular basis.
2. Pull through and solvent very good for general cleaning of lightly fouling bores but insufficient for removing carbon and copper fouling buildup.
3. Bore can be de-fouled without stripping action by carefully inserting cleaning rod with solvents into the muzzle. Common sense is all that is required. Do not neglect the bore out of fear of damaging the muzzle.
4. Use white poly pads with solvent for harsh scouring action without threat to muzzle.
5. Full abrasive throat polishing tasks require full rifle dis-assembly, inserting rod from breech end.
6. Use very light lubricant within tube magazine and spring. CRC Long Life recommended (use cleaning rod).
7. Grease or oil ratchet mechanisms.
8. Grease on all outer metalwork including within forend and butt stock.
9. Light oil (CRC Long Life etc.) sufficient for protecting high sheen brushed stainless rifles.
10. Use motor oil, diff oil or chain bar oil on pull through for general protection of bore (chrome moly intermediate term).
11. After storage, pull through with solvent, dry pull through and then pull through with field lube.
12. Store family heirlooms and collectibles with grease in bore.

The seven basic rules of firearms safety (NZ Arms code)

1. Treat every firearm as loaded.
2. Always point firearms in a safe direction.
3. Load a firearm only when ready to fire.
4. Identify your target beyond all doubt.
5. Check your firing zone.
6. Store firearms and ammunition safely.
7. Avoid alcohol and drugs when handling firearms.

About Nathan Foster

Nathan Foster lives and breathes what he teaches. Nathan has a long established background in the gun industry, recognized for his extensive research and for educating and supporting hunters around the world.

Nathan has taken over 7500 head of game, testing the performance of a wide range of cartridges and projectiles, and is a worldwide expert in the field of terminal ballistics. His ongoing research has been carefully recorded, analyzed and documented in his online cartridge knowledge

base for the benefit of all hunters and shooters (www.ballisticstudies.com).

Rifle accurizing and long range shooting are among Nathan’s specialties. For many years, Nathan has provided both rifle accurizing services and a long range shooting school. Nathan is also the designer of MatchGrade bedding products and has assisted many 1000's of hunters worldwide to improve their rifle accuracy, shooting technique and hunting success.

The Practical Guide To Bolt Action Rifle Accurizing and Maintenance draws on Nathan’s many years of experience accurizing factory and custom rifles.

Broken down into a clear and concise guide, this third book in the series takes the reader step by step through the process of accurizing and maintaining the bolt action hunting rifle. Like the Practical Guide to Long Range Hunting Rifles and The Practical Guide To Long Range Hunting Cartridges, information is provided in user friendly layman’s terms to help readers of all levels of experience achieve their goals.